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SCHOOL HYGIENE

LEO BURGERSTEIN

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SCHOOL HYGIENE

SCHOOL HYGIENE

BY

LEO BURGERSTEIN, PH.D., LL.D.
(VIENNA)

TRANSLATED BY

BEATRICE L. STEVENSON, AND
ANNA L. VON DER OSTEN

WITH 43 ILLUSTRATIONS AND DIAGRAMS

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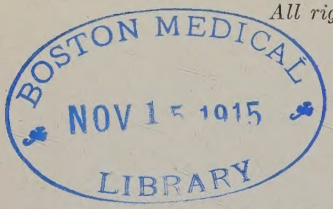

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January, 1915

INTRODUCTION TO THE AMERICAN EDITION

The present century is discovering that the care of children is the most important thing in the world. Except in so far as children possess vitality, integrity and intelligence, nothing is worth while. In the past our cities have been built as if manufacturing and commerce were the great aims of the world. The discovery of childhood is the supreme achievement of our day. The time is coming when cities will be built so that children may be well and happy, so that the treasures of past civilization, the precious inheritance of the achievements of the human spirit, shall be passed on to them most effectively.

One of the leaders in this world-reconstructing view is Professor Leo Burgerstein, who has taken as his special theme the health of the school child, realizing that children in school are kept in school and under school influence, most of the hours of most of the days of most of the years of childhood. He says that the school must itself become a health-promoting agency, and the school curriculum a means which shall so influence the children that those who take part in it shall be better off in health and vigor than those who do not. The world is indebted to Professor Burgerstein for his scientific achievement, for his

breadth of scholarship, as well as for the practical nature of his teachings.

This little book will bring to those American readers who are not already familiar with Professor Burgerstein's larger work in German, his general point of view with reference to this whole subject of the health of the school child.

LUTHER H. GULICK, M. D.

NEW YORK, OCTOBER, 1913.

PREFACE TO THE THIRD EDITION

The preface to the first edition closes with the words: "It is difficult to set forth the results of an investigation in a way so as to be readily understood by all. I shall be happy if I find that I have succeeded in this endeavor." The rapid sale of the second, extensive edition has shown that the chosen way was the right one.

In addition to a change of text and enlargement of the index, the new edition of this little book, which has won many friends and received much recognition, has been altered only to include our present knowledge of school hygiene. A few parts have been omitted, some chapters have been made more comprehensive, and new and more instructive illustrations have been added. The great increase in material with no corresponding increase in the size or price of the book is due to the good management of my publishers, and I take this opportunity of expressing to them my thanks for their services.

I desire also to thank my honored friend, Mr. Arthur Lieberman of Vienna, for his kind assistance in correcting proofs.

Leo Burgerstein, Ph. D., LL. D.

Vienna, April, 1912.

MEASUREMENT EQUIVALENTS

1 meter	=	3.3	feet
1 meter	=	100	centimeters
1 centimeter	=	.39	inch
1 centimeter	=	10	millimeters
1 millimeter	=	.039	inch
1 square meter	=	1.2	square yard
1 square centimeter	=	.15	square inch

x degrees Centigrade = (X x 1.8) + 32 = x degrees Fahrenheit

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INTRODUCTION

It is a well-known fact that the beginnings of many modern activities can be traced back thousands of years. Such is the case with school hygiene, for evidence of its existence has been found as far back as the days of Greece. Even the modern form of school procedure is much like that of a far-removed age; the schoolhouse of the present with its equipment agrees in some respects with the schoolhouse and equipment described by Furttenbach.* There have been times in Germany when public opinion was disposed to consider with indifference a sound physical development in relation to school work. Even to-day, while the teaching profession generally appreciates the importance of school hygiene from a theoretical standpoint, in actual practice we are still feeling the effects of the earlier prejudiced times, and much progress needs to be made. Nevertheless, the right of the child is one of the demands of the times, and this demand includes the protection of the child's health in public institutions.

As the father of modern school hygiene we acknowledge the eminent physician, Johann Peter Frank, who, in the second volume of his great work, "System einer vollständigen medizinischen Policey,"† sum-

*Furttenbach. "Teutsches Schul-Gebäw," Augsburg, 1649.

†Frank, Johann Peter. "System einer vollständigen medizinischen Policey," Mannheim, 1780.

marized the meaning of school hygiene. The science has, however, been broadened and made effective only during the past fifty years, when medical specialists, in the interests of scientific knowledge, have examined large numbers of school children to determine what disturbances of health are traceable to school life. In the train of these examinations many thorough investigations were taken up to determine the physical condition of school children and the state of sanitary equipment of the schoolhouse; and much knowledge has been gained and many hygienic improvements have been introduced. In comparison with research in these directions, the hygiene of instruction made its appearance relatively late, and is therefore far from being cleared up sufficiently. The demand for it must come from the schools, its teachers, and the specially trained school physicians. The hygiene of the teaching profession, developed in the spirit of modern scientific research, is likewise only in its infancy.

Practical hygiene so far as it concerns all matters of the school will succeed only when schoolmen generally, teachers, and the pupils themselves, understand the rules of health. As for the actual instruction in hygiene in the school, the subject is so comprehensive that it is impossible that all teachers shall be experts in this particular field; hence a demand has gradually arisen for a person especially trained in this branch of school work, namely, the school physician.

It is important that the teaching profession take an active interest in school hygiene; there is no better

way toward realizing the ideals of the science or of verifying the results of research.

The fundamental points to be emphasized in this book have thus been indicated. Their discussion, which will be concise, will include matters of theory and practice in various countries. It will materially aid the advance of the science if teachers everywhere will accept the suggestions concerning the theory and practice in other lands in the spirit in which these suggestions are made, and as an incentive to progress in their own schools.

SCHOOL HYGIENE

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I

THE SCHOOLHOUSE

1. General Planning and Erection

The problem of schoolhouse planning differs from the ordinary house planning in this respect that almost every condition is altered. In a dwelling house the place where one sits to read is near the window; in a schoolroom even the corners far removed from the windows must be used for this purpose. The very moment the threshold of the schoolhouse is crossed, the difference is apparent; many feet passing over a threshold bring in an unusual amount of dust. The school stairways, too, must at times bear the weight of crowds, and rooms which must accommodate many individuals make proper ventilation a serious matter. In fact, the characteristics of the schoolhouse serve to emphasize the difference between it and the dwelling.

Planning.—In order to avoid mistakes which cannot be remedied later, when the schoolhouse is being planned close attention must be given to the hygienic aspects. This requires careful study at the outset, a fact which has unfortunately been learned by experience in those communities where it has been found that an attractive appearance does not always mean

good planning or suitable situation. Schoolhouse planning demands experts. In rural communities good model plans might be edited by the municipal authorities. In this way, even a small community could erect a satisfactory schoolhouse and be stimulated to undertake the work because those immediately interested, as, for instance, business men, could superintend the matters of planning and erection. It is, of course, of material help toward the securing of good schoolhouses if the state is able to assist by subscribing loans without interest. Small and average-sized cities may succeed in securing good plans by initiating a building contest. The sketches submitted in the contest should be passed upon by an expert in school hygiene. The primary aim in all cases must be to secure ideally hygienic conditions as far as the finances will permit. This necessity must precede all claims to beauty; *panem et circenses*, not the reverse, should be the rule. In the larger cities the aim should be a comprehensive study of schoolhouse construction in other countries as well. This study should include a review of the existing literature on the subject, and also the personal observations of an architect especially interested in this branch of his profession.

Site.—It must be emphasized again that not every building will do for a schoolhouse and that the schoolhouse demands special construction. The choice of a site is important. The essentials are: quiet, air as good as the locality permits, and light which is not interfered with by adjoining buildings. A further essential is that these conditions be assured for the future. It happens frequently, especially in

small towns, that an otherwise desirable schoolhouse is placed entirely without necessity on a thoroughfare, merely because the town is proud to show it. The noise and dust of the thoroughfare prove disturbing factors. If the building must be put on a principal street, by all means let the corridors be on that side while the classrooms face the rear; but a more favorable location should be found, if possible. Furthermore, in small places the plans should be such as to admit of the addition of annexes or stories.

In rural districts, in order to have a generally accessible schoolhouse, one must take into account the lay of the land, the distribution of the population, and the state of the roads. Instead of a separate school for each small village, it might be desirable to have one large school for a number of villages. The pupils might be brought to the school by conveyances, as is the system in vogue in certain parts of the United States, where several of the states have already passed legislative enactment on this point. It would be most helpful, both from the standpoint of hygiene and from that of school attendance, if in rural districts it were possible during the inclement season when the snow lies deep and transit is difficult, to organize a system whereby particularly the smaller children may be carried in conveyances alternatively by the farmers to and from school. In the northern part of Scandinavia, where the farms are widely scattered, it has been found feasible to form so-called *Wanderschulen*. In these, a number of children are fully taken care of for a number of weeks, until the teacher must move on to the next post.

When quiet and good air are aimed at it is well to remember that these conditions are not likely to be secured where school buildings are situated in the vicinity of railway stations, near laundries where chemicals are used, or near factories. It would be a distinct advance if this matter could be controlled by law, for instance, the prohibition of such establishments within a mile of the schoolhouse.

Cottage Plan of Schools.—In large cities, a realization of these ideals—quiet, good air and good light—is not easy, but the evils might be minimized if the municipal authorities would look ahead a few decades in the growth of their city and restrict certain sites in the suburbs for the use of schoolhouses and playgrounds. In the meantime, such tracts of land might be leased out for agricultural purposes. Some large cities have built their schools on the plan of one schoolhouse to so many thousand children, but this procedure does not always express a wise, far-sighted policy, for while the proportion of school children to the total population (in most countries from 13 to 20 percent) is known, in some sections, for instance where a factory is being set up, the school population will increase out of all proportion to the provisions that have been made. To meet such needs, large school barracks must then be constructed in haste. Such cheap, lightly built structures, while they sometimes admirably relieve a temporary need and have been known to give good service for years, are not to be recommended for general use, and should merely serve as an emergency measure in large cities. It may be that from some of the advantages of the

school barracks has originated the cottage plan of school building, *i.e.*, instead of one large schoolhouse, a number of smaller, separate units. The advantages here are better air and less mutual disturbance; it is easier to clear the rooms in case of fire, and the closing at times of epidemics need only concern one unit. On the other hand, drawbacks are again met with in the tax put upon the central heating system, and if shower baths are used the danger in cold weather of having

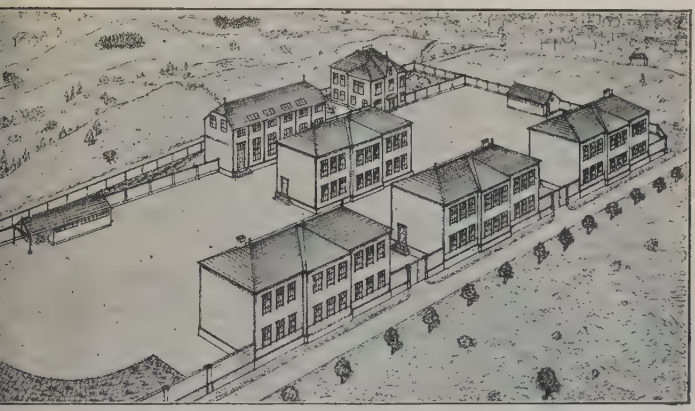

FIG. 1.—Pavilion school at Drontheim, Norway. Perspective.

the children pass after the bath from one building to another. The comparatively large amount of space required for the pavilion school renders it not generally practicable and for this reason but few such schools have been erected, though they are to be found here and there, especially since Beutner in Ludwigshafen (Germany) has supplied a model. Figs. 1 and 2 show examples of the Håkonson-Hansen pavilion at Dront-

heim in Norway. The schoolhouse is of wood, centrally heated by steam and ventilated mechanically. The house in the rear of Fig. 2 is the gymnasium

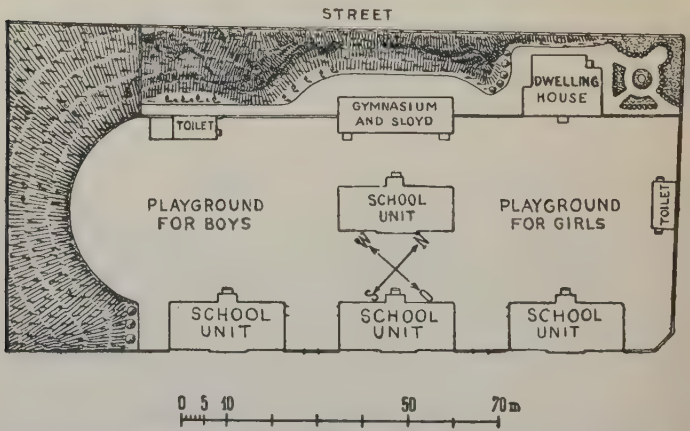

FIG. 2.—Pavilion school at Drontheim, Norway. Ground plan.

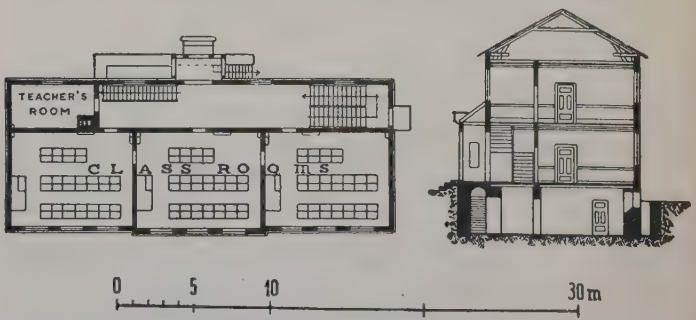

FIG. 3.—Ground plan and cross section of a school unit at Drontheim, Norway.

where classes in physical exercise and training for sloyd work are conducted. Fig. 3 shows the ground

plan and a cross section of one of the pavilions, with six classrooms, each accommodating 36 pupils.

Points relating to the size of school plots will be taken up later; it is sufficient to say here that the grounds can never be too large when play spaces are taken into consideration. School buildings should never be placed on sites formerly used as refuse dumps, on ground where underground currents of water come near the surface, or in marshy places.

Location of Schoolhouse.—A much discussed question is the location of the school building with respect to the point of the compass. The great influence that the sun has as a hygienic agency is well expressed by the forceful old Italian saying that, "Where the sun never goes, the doctor must go." Sunshine is especially important for the physical and moral health as well as the happiness of children. On the other hand, the sunlight which falls directly on the page when the child is reading or writing is harmful to the eyes. Curtains or screens are then necessary. It must also be remembered that a very sunny room well filled with children is decidedly uncomfortable in summer. Local conditions, such as a mild or a severe climate, strong or badly nurtured children, distribution of class hours, etc., play important parts. For the health of the children, sunny situations are on the whole preferable to the northern exposure which has recently been advocated. The value of sunshine is not to be overlooked when ideal situations can be obtained. In the large city, where a schoolhouse must be placed of necessity in a street with other houses, the choice of location of the rooms is naturally

strictly limited to their distribution within the schoolhouse.

Water Supply.—The quality of the water supplied to a school is a matter of the utmost importance, as impure water may be the source of dangerous disease. Filters are not to be recommended because they soon become choked with bacterial organisms and are sterilized with difficulty. At the first appearance of an epidemic which points suspicion to the water supply, care should be taken to sterilize all water used for drinking purposes. It should be boiled for at least half an hour in bottles placed in a kettle filled with water. A little cold tea or lemon juice added to the boiled water takes away the flat taste.

A central water supply is gradually being recognized as a necessity in all large communities, for a badly situated or a badly managed well is too apt to become a source of epidemics.

Wells.—In country places, which lack a central supply and where it is not always possible to have scientific supervision to insure purity of the water, especial care should be given to the location of the well; the site must be absolutely without question. Unfortunately rural wells are often a mockery of the laws of hygiene. Hence the school well should be a model to the community. To inculcate this lesson in the children, on occasions it might be desirable to show a plan and cross section of a good well to the older pupils, and to explain to them the dangers of a bad location. Concerning a good situation for a well, the points are briefly these. If the ground has good filtration powers, a vertical depth of about 5 meters

insures water free from bacteria; the filtration of water running obliquely to the well must also be considered. At all events, deep wells of at least 8 meters are superior to surface wells. It goes without saying that there should be no toilets, lavatories, or manure heaps nearby, or even within a radius of 10 meters. Wells should be dug to the depth of at least 5 meters, and the shaft should be water-tight. It is desirable to project the coping of the well about 30 centimeters above the ground; the cover also should be water-tight. It is better not to have the well-pipe-drop in the middle of the shaft. The spout of the pump should project beyond the well covering, and the trough to carry off the water should be water-tight and lead at least 5 meters away, so that there shall be no soaking in of dirty water. Drilled or driven wells are to be advocated where the ground is adaptable.

The school well has been discussed at length because investigation has proven that in rural districts it is frequently found to be a menace to public health, and the opportunity of calling attention to this evil may often be presented to those informed on this important matter of hygiene.

Drinking Fountains.—The drinking fountain is next in importance to the water supply. In most schools the only provision made is the common drinking cup, in some a few tumblers are provided for a whole class of children. It will generally be found that school children rarely rinse the common cup; or if they do, the operation lacks thoroughness. The saliva adhering to the rim can only be efficiently removed by a strong flow of water, and there is little inclination

on the part of children to do this thoroughly and sometimes also there is a lack of time. The serious consequences can readily be foreseen; a child infected with diphtheria may spread the disease among those who drink after it out of the same cup. Individual drinking cups, one for each child, should be used in place of the common cup. For those who are too poor to buy a cup, some charitable provision might be made. This individual cup should be kept in the school bag or in a special place provided for it in the desk similar to that provided for the inkstand, or else the cups should be left in a designated spot and numbered for identification, the younger pupils having stars, or a cross, or half moon to identify theirs. It devolves upon parents and teachers to instruct the children not to lend their cups to others.

FIG. 4.—A drinking fountain requiring no cup.

Where running water of sufficient pressure is available, a drinking fountain may be set up, one that requires no cup, but from which the water gushes directly into the mouth when a valve is pressed, as shown in Fig. 4. When the child has finished drinking, he releases the valve and the jet ceases, but the water continues to flow below the valve, washing away the drops which have fallen back from the

mouth. In this way the lips of the drinking person do not touch the opening of the fountain which is below him in the depth of the basin. Fountains such as these were introduced into a Vienna school in 1906 on the occasion of an anniversary.* It is greatly to be desired that other cities will follow the example of this school by the introduction of equally hygienic improvements on similar occasions. In the United States fountains are used extensively as a result of the legislation which has been passed prohibiting the use of public drinking cups. While New Jersey, Florida and Indiana led the other states in this action against the common cup, there are at present more than a dozen states and fully as many cities which have done away with the use of public cups in schools.

Construction.—There is no special need for dwelling upon the hygienic side of building materials or construction further than to say it is generally conceded that a cellar is desirable, though not absolutely necessary when there is a good foundation of concrete and floors which will keep out the cold. It is well to prevent the rise of ground water in the walls by using layers of insulating material in the foundation under the floors. Only dry and moisture proof material should go into the making of partitions. To get the necessary warmth and required freedom from noise it is best not only to deaden the beam coverings and flooring, but also partly to fill up the intervening spaces. Certain newly devised building materials,

*The model was a good, cheap one invented by Oreffice of Padova (Italy).

made of iron and concrete, are admirable for filling in. House fungus, the presence of which may become unhygienic and a source of expense when it requires removal (though not considered a poisonous growth) may be avoided by the use of thoroughly dried wood. Staircases which are absolutely fireproof both as to the treadway and its covering are essential. The new schoolhouse should not be thrown open for use until it is thoroughly dried out.

Schoolhouse Entrance.—No schoolhouse, not even the smallest, should discharge its pupils directly into the street. In large schools, at least one entry for every three hundred pupils is desirable. In the entry room of every schoolhouse, large enough provision should be made to have the pupils wipe their shoes thoroughly before coming into the classrooms. Since the prevention of dirt in the house is easier attended to than the operation of cleaning, the pupils should become accustomed to make systematic use of the dust mats, etc., from the beginning of their schooling.

Waiting Rooms.—Waiting rooms situated near the entrance are most desirable in city schoolhouses, for the convenience of those who escort the children to and from school.

Cloak Rooms.—Of especial concern to the health of the school population are the rooms where wraps and umbrellas are deposited. If these articles are kept in the schoolroom itself, the warmth of the room and the dampness of the clothing together will soon cause deterioration of the local atmosphere. It is by all means desirable to have a special cloak room. Such accessory rooms have gradually become an acknowl-

edged necessity in many countries. (See Fig. 5.) It is also recommended that in the cloak room provision be made for drying the damp footwear of the children and that each child might have a pair of dry shoes and stockings for change. Cloak rooms should, of course, be well heated in winter and well ventilated at all seasons; children who come early to school might be appointed to attend to these conditions. Hallways may also be used as wardrobes.

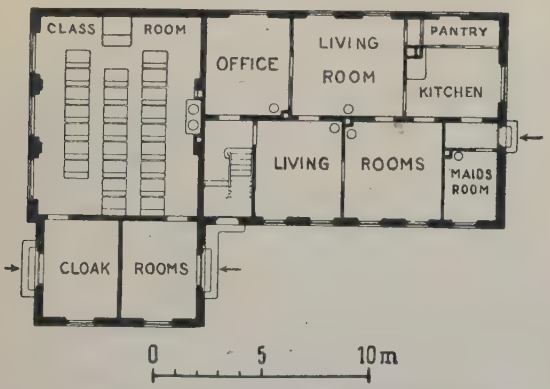

FIG. 5.—Ground plan of a one-room Danish schoolhouse.

Lavatories.—The cloak rooms found in the London schools deserve special commendation, because of the hygienic provisions they make for the cleanliness of the pupils. As the children come in, a teacher inspects them, and those who are in need of soap, water and a towel, are accorded these privileges. There are four washstands for every one hundred children of the school. (See Fig. 6.) In respect to that much in-

volved question, the hygiene of the towel, we should like to suggest that in schools not frequented by the very poor, each child should bring his own towel with him to school and carry it home to be dried. The very poor children could have towels given to them.

Indoor Playgrounds.—School children should have a well-warmed room in which to spend the recess in inclement weather. (See Fig. 8.) As it is generally admitted that the needed amount of play space for each child, even in large cities, is at least one-half

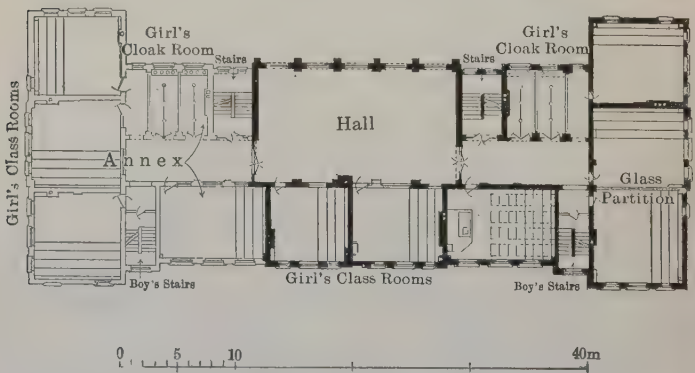

FIG. 6.—Plan of the first floor in a London public school accommodating twenty classes.

square meter of space, the amount necessary for this purpose can easily be computed. The free space thus available for the recreation of the children may be augmented by the wardrobe space, *i.e.*, where the clothing is hung in the corridor in a wire cage open to the air. On the whole, it would seem to be wise to make the corridors only just as wide as is absolutely

necessary, and the stairways not more than a meter in width (but increasing the number of such stairways), in order that the common recreation hall for all the classes on a floor may be as large as possible. Fig. 6 shows a hall of this character. It admits of easy supervision and may be used as an assembly room by a number of classes.

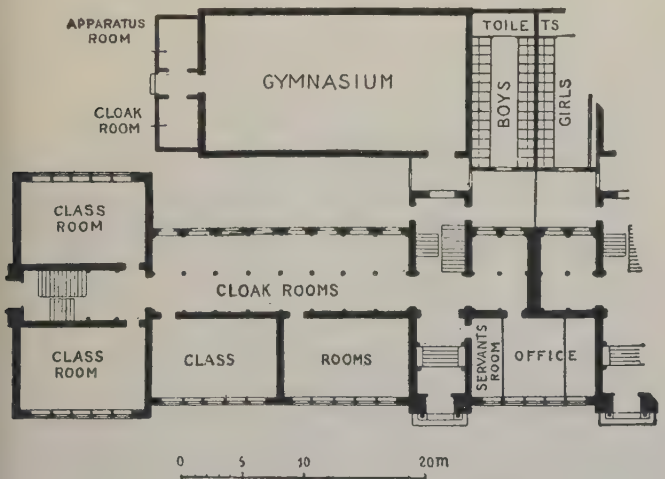

FIG. 7.—Ground plan of a public school (32 classes) in Frankfort, Germany.

Arrangement of Rooms.—In the arrangement of the rooms within the schoolhouse, the classrooms must necessarily receive first consideration with respect to good light and a quiet location; passageways, stairs, offices, showrooms for collections of educational appliances, reception rooms and assemblies take second place. The indoor recreation rooms, as well

as the playgrounds, should be located so as to be easily supervised. Most unfortunate is the location of a schoolhouse in a crowded quarter, where almost all space is used for stairs and classrooms; greatly to be recommended on the other hand is the type of schoolhouse with classrooms on only one side of the corridor as shown in Fig. 7.

In the following paragraphs a few selected ground plans for different types of schools are described.

Ground Plans.—One of the most significant means for the dissemination of education is the one-roomed schoolhouse of rural districts. The plan of a schoolhouse of this type officially recommended in Denmark is shown in Fig. 5. Observe the small number of children accommodated, and also that the boys and girls have separate cloak rooms. The house is intended as a home for the teacher and his family and contains a guest chamber in the attic, besides other living rooms and premises not shown in the sketch.

Fig. 6 shows the ground floor plan (girls' floor) of a three-storied London public school accommodating twenty classes. The cloak room with lavatory and hall, where children can gather in bad weather before morning instruction begins, will be seen. The boys' floor, the stairs leading to which are shown, is above, while the kindergarten is below. Fig. 7 shows the left half of a ground plan of the girls' division of a four-storied public school, accommodating altogether thirty-two classes, found in Frankfort-on-the-Main (Germany). It will be observed that the window posts are narrow and that the classrooms are situated

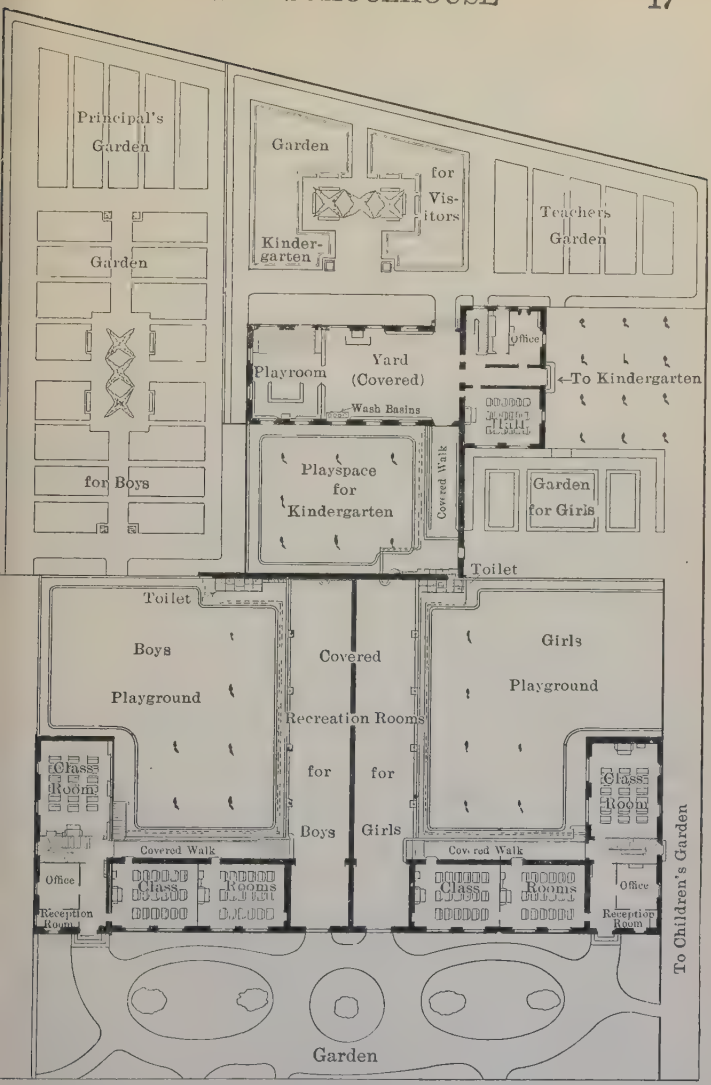

FIG. 8.—A school and its grounds at Viroflay, France.

only on one side of the corridor, the gymnasium being only one story high.

In France and England, and recently in Germany and Italy, the kindergarten has been combined with the elementary school. Fig. 8 shows a ground plan of a French group of schools (*groupe scolaire*). The elementary school is designed for three boys' and three girls' classes, and the kindergarten is in the rear. The upper parts of the buildings not shown in the sketch contain janitor's quarters, which are accessible by a separate stairway. Of special interest are the covered outdoor recreation spaces and the playgrounds.

The Classroom.—From a discussion of schoolhouse plans in general, we turn to a consideration of the individual rooms used for educational purposes, including the gymnasium. Of these, the ordinary classroom is the most important. It is the one room in the school building where the pupil spends most of his time and performs most of his tasks, including reading and writing, accomplishments which under unfavorable conditions may injure his health. A complete understanding of the hygienic requirements of this room will be gained only after a detailed consideration of lighting, airing, and heating.

2. Lighting

Hermann Cohn of Breslau, who for years worked in the interests of school hygiene, once said that a schoolroom can never have too much (diffused) light. The light of the sun is not only an aid to cleanliness and a foe to pathogenic micro-organisms, but the degree of

sunlight also has important bearings on the general health of the body, as regards its functions of respiration, digestion, etc., as well as in the preservation of unimpaired eyesight and good posture. At a distance of 2 meters from a window, the light is only about 80 percent as bright as at 1 meter, at 3 meters only 50 percent as bright. A realization of such values brings out the necessity for special study of how to light the schoolroom so as not to injure the sight of any of the occupants.

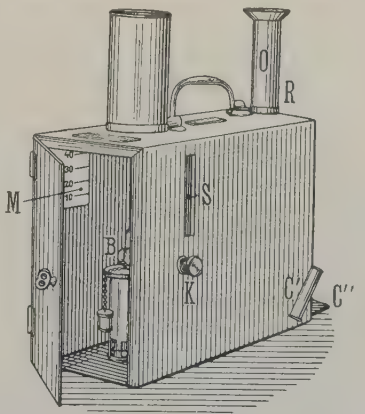

Fig. 9.—Photometer by Wingen.

Light Measurement.—The amount of light in different parts of the room can be ascertained and expressed in figures by means of the photometer. It can be calculated in meter-candles, 1 meter-candle equalling the intensity of light which the flame of a standard candle throws on white paper at a distance of 1 meter. The usual requirements are 25 meter-candles measured in white light.

An excellent, though costly photometer, is that of Weber; one designed by Wingen is smaller and simpler but not so exact. The latter (Fig. 9) consists of a little box about a span high in which is a benzine flame B, observed through S. The height of this flame is

regulated by means of the knob K, so that the amount of light cast upon the prism within the box at C′ (observed at M) can be made to correspond with the daylight cast on the pupil's desk at C″. Since the actinic values in the benzine light and daylight are not the same, it is necessary to compare the red part of each (R, the red glass), and afterward to multiply by a factor, in order to obtain the equivalent candle power of the daylight.

Angle of Light.—There are also instruments for computing the angle of light falling on a pupil's desk. By dividing the equator S of a globe into 360 degrees and constructing a square over each degree, or a "square degree," we have over 41,000 such square degrees for the whole of the globe. If one plots the number of square degrees of sky sending light on a horizontal surface, the so-called room angle is obtained, of which 50 degrees are demanded for each pupil's place. No computations are necessary with a little apparatus made by F. Pleier in Karlsbad.* It consists of a pocket camera (Fig. 10) in which a glass screen is placed between the plate and the lens.

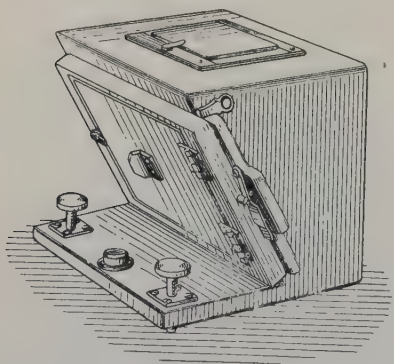

Fig. 10.—Pleier's camera for measuring the angle of light.

*Institut, F. Schmidt & Haensch, Berlin.

This screen is made up of parallelograms each corresponding to 4 square degrees; but these parallelograms are of different sizes having been graduated according to the relative values of the light, corresponding to a greater or less angle of incidence. If the camera is placed on the child's desk and directed toward the light, a photograph can be taken like that of Fig. 11. It is possible in this way to estimate the light coming from four windows. In this picture the number of square degrees of direct daylight, as well as reflected light is given, and all without further reckoning, as the correct room angle is obtained because the differing light values in connection with the angle of incidence are already taken account of by the screen within the camera. By means of the photometer, especially by means of the apparatus to measure the room angle, it is possible to determine whether a room has sufficient light. Unfortunately, if this is found not to be the case improvement seldom follows. As a matter of fact, the many badly lighted classrooms still in existence date from the time when hygienic matters were not considered; in such rooms children have suffered for decades. But as far as the building

FIG. 11.—Photograph taken with the Pleier camera for measuring the angle of light.

of new schoolhouses is concerned, our whole aim must be to see that badly lighted rooms shall no longer be erected, and this ideal does not involve the question of cost as an insurmountable difficulty. Still a school plan based on the most finished scientific methods may not be attainable even in large cities, not to mention the smaller towns, and on the other hand it is a fact that up to the present for various reasons the exact and scientifically incontestable minimum amount of light

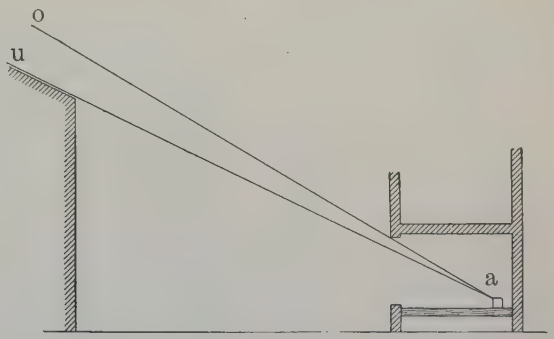

Fig. 12.—Measuring the light on the desk farthest from the window.

necessary from the hygienic point of view has not been stated. But the following is a simple rule which any rural carpenter might follow when constructing a new school building. The rule merely demands direct daylight even on the desk farthest from the windows. Fig. 12 shows a carpenter's cross-section cut of a schoolhouse and one wall of a nearby building. The house shows the outside walls, one room with a window and a desk in the farthest corner. A line,

o—a, is drawn from the pupil's desk to the top of the window and extended outward; another line, a—u, is drawn from the top of the nearby building or whatever obstacle cuts off the light, and is brought to the pupil's desk. The angle between these lines shows the path of direct light to the desk.

This aim of direct daylight on the desk of the pupil in the farthest corner of the room should be possible even in the largest cities. If it can not be achieved for the lower stories, these should not be used for school purposes, but rented out, or other disposition made of them. It need hardly be mentioned that in planning a schoolhouse, the building laws of the community should be carefully considered, so that it may not happen that well-lighted rooms will subsequently be deprived of their light through the erection of towering structures in the neighborhood.

Direction of Light.—When schoolrooms are lighted by windows on only one side, as is usually the case, the windows should by all means be situated to the left of the pupils, for light coming from the left is most desirable for writing. Lighting from the front is not to be considered; if the light comes from the rear it blinds the teacher and increases the difficulties of supervision, but lighting from high up is not to be condemned and may have the advantage of illuminating the blackboard in front of the pupils. The desirability of light coming from both sides is a matter of dispute. If the aisle is located to the right of the room, the light from that side, even where there are windows to both sides, can not be as strong as that coming from the left. In so far as the space on the

righthand wall is not to be utilized for a door, or possibly for radiators and ventilators, it might be desirable to plan for windows above, in order to secure good ventilation. No disturbing shadows will be thrown by windows thus located.

Windows.—The matter of the schoolroom window is not a simple one from a technical point of view. It goes without saying that the windows should be divided symmetrically and the spaces between should be as small as possible. A glance at the windows of the classrooms in Fig. 7 shows carefully studied construction. Broad frames not only take away considerable light in general, but they also especially darken the places of pupils sitting beneath, and much more so if the spaces between are used as wardrobes. Furthermore, the window must be rectilinear, rounded or pointed windows being entirely out of place in the classroom. The transom of the window should extend as far as possible to the ceiling, as in this way the angle of incidence of the light rays and the bulk of the direct beams will be increased. Window frames and intersections should be as small as possible and painted white. Window panes absorb quite a good deal of light, as Selter, in Bonn, has proved by his experiments; and this is particularly true of dusty windows. For this reason, the windows of the schoolroom should be washed frequently. It would be well to have double windows to insure warmth in winter, or at least in single windows to have two thicknesses of glass 5 centimeters apart.

But the schoolroom window must also serve the purpose of airing. It is therefore necessary that

the windows should be such as to admit of being opened quickly and easily, especially the upper parts; the lower sections when opened must not hinder passage.* Sash windows are better than French windows for the schoolroom.

Curtains and Shades.—In connection with the high and large window, arises the problem of curtaining or shading with a minimum loss of light. The shades must often be drawn when the window is open, and they should be adapted for this use; and they should be so arranged as not to admit oblique rays of light at the sides. The shades when not in use should fit into an opening made in the window sill, which is preferable to the folded shade at the top of the window where it obstructs necessary light. Shades which can be rolled up tightly are not objectionable when placed at the top of the window. The shade material is of importance; it must be of good quality, plain (not striped), not too thick, white or cream-colored. Fine white shirting, light in quality, is the most suitable. The shades should be arranged in such a way that they can easily be taken off to be cleaned.

Light Reflectors.—It might be possible to improve the lighting of old, badly built schoolhouses by reconstructing the window spaces, making them broader and higher, but because of the prohibitive cost, this is rarely undertaken after a schoolhouse is once built. Improvements in lighting may also be affected by the use of glass reflectors, such as the American

* (The windows which are considered here are of the casement order exclusively used in Europe. Translators.)

Luxfer prisms, or the French *verres prismatiques*, which are somewhat cheaper than the first named reflectors or mirrors. But in order to make these reflectors really serviceable, they must be kept absolutely free from dust.

Artificial Lighting.—The discussion of lighting thus far has been with reference to daylight, but unfortunately it is often not possible to depend upon that means alone, and artificial lighting must also be considered for the schoolroom. In the home it is possible to have the lamp on a table, to the left of the reader. It is not possible to give every pupil in the schoolroom an equal advantage, for a crowd of children must all have a free line of vision to the blackboard. How many children in brightly lighted rooms do we not see at work on their blank books in the deep shadow made by the book or the hand; that is, in a flood of light there are shadows just where the greatest intensity of light should be! Erismann of Zürich has found that an occupied desk did not have quite six percent of the light that fell on it when the desk was empty. But apart from this, unfortunately the light itself is not always of sufficient intensity, or it falls so that there is a glare in the eyes of the pupils as they glance at the blackboard. Further, the strength of the light depends as much on the distance as on the side from which it comes. It is also worthy of mention that some kinds of light have bad effects on the air of the schoolroom by generating noxious gases.

Electric lighting, as well as lighting by Welsbach lights, has done much to obviate such disadvantages.

Kerosene or alcohol lamps are not desirable for school use because they require too much attention. Modern lighting has achieved its greatest success in the electric bulb, which has enormously increased the intensity of available light with purity of the air and a minimum degree of heat and dryness.

Diffused Lighting.—But the difficulty of overcoming, with any kind of direct artificial light, shadows made by the hands and bodies of the pupils still remains. This disadvantage has been met by Jasper of Paris who discovered a method for diffusing light. For this plan of lighting, the ceiling and the upper third of the walls are painted a clean white. The lights are hung a short distance from the ceiling, about half a meter, and each lamp has underneath it an opaque shield which reflects light on to the ceiling or on an upper shield, that is, the lamp sends its light upward not downward.

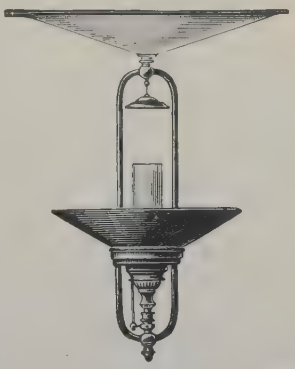

FIG. 13.—Diffused lighting by Welsbach lamp.

The utility of such lighting has been demonstrated in many localities. Fig. 13 shows a lamp designed by Egloff in Turgi (Switzerland). The advantage of indirect lighting is this, that the ceiling of the room, as well as the upper walls, throws the light in all directions, and while the intensity of light reaching

the desk is somewhat diminished because a part is absorbed, the distribution is much more even than in direct lighting; and, what is still more important, there are no shadows. Such diffused lighting resembles very closely the daylight of a clouded sky. Because of these advantages, indirect or diffused lighting is being rapidly adopted in all places where the formation of shadows is a handicap. In the use of this light, at first the absence of shadows is confusing. That less light is needed has been demonstrated by the experiments of Prausnitz in Graz (Austria). In a classroom measuring 105 square meters, where the pupils were receiving instruction in drawing, 18 Auer (Welsbach) lamps gave amply sufficient diffused light for the finest work. In the ordinary classroom there should be one Auer lamp for every 10 square meters of floor space; under such conditions, the light will be better than that supplied by an equal number of lamps with direct lighting. One disadvantage, however, consists in this, that in dusty, sooty localities the white ceiling and walls, as well as the reflectors, quickly accumulate dust. The difficulty of cleaning is not insuperable if the person in charge of the cleaning is supplied with a small mirror adjusted on a long pole; but unfortunately, few janitors will bestow any care on surfaces over three or four meters from the floor. The lighting, of course, suffers a steady decrease in intensity as the room becomes dingy.

Direct Lighting.—Where direct lighting is used, lamp shades are necessary. It is well to have the shades large. If electric glow lamps are used they may

be fixed without shades directly on the ceiling, for though the intensity of light is lessened somewhat by the increased distance, the diffusion is better and the shadows are less pronounced, as is proved by the experiments of Reibmayr in Innsbruck (Austria). With Auer lights and direct lighting, eye shields should be used. Flickering lights should never be tolerated in schoolrooms.

Gas Lighting.—Gas lighting is unsatisfactory because of the danger of unsuspected leakages which may deteriorate the air of the rooms and constitute a money loss as well. Absolute freedom from leakage, however, may now be assured by a small, inexpensive apparatus by means of which a daily test can be made. It is well to insert cocks at convenient places when the building is in course of construction, as it may be practicable to turn off the gas supply in unused portions of the building and during vacations, thus preventing possible leakages. The main cock should be in an accessible place, not in the cellar.

3. Ventilation and Heating

Condition of the Air.—Dry air is composed of about 79 percent nitrogen, 20.94 percent oxygen and 0.04 percent carbon dioxide. The air as it comes from the lungs has about the same quantity of nitrogen, 16.03 percent of oxygen and 4.38 percent of carbonic acid gas. Its oxygen content has thus been reduced about 20 percent, while the carbonic acid gas has increased 100 percent. In addition, small quantities of volatile substances have accumulated which tend to

render a well-filled room unpleasant if there be no ventilation. The offensiveness of the room is increased when the occupants have not kept themselves clean nor provided themselves with clean undergarments (cf. school baths p. 63–64). It is difficult to demonstrate the presence of these volatile organic stuffs in chemical terms; hence von Pettenkofer in Munich took the quantity of carbonic acid gas in a room as an indication of the quality of the air. He claimed that air is injurious when the ratio of carbonic acid gas is over 1 per 1,000. Tests made in badly ventilated schoolrooms have revealed the presence of 14.8 parts of carbon dioxide to 1,000 of the air in the room. In a crowded, unventilated room the carbonic acid increases after only twelve minutes to the maximum, 1 to 1,000. This applies to a room where 4 cubic meters of air space are allowed for each pupil.

It must be mentioned, however, that von Pettenkofer's conclusions are open to question and that the experiments of Flügge, made in his laboratory in Breslau (Germany), have shown results which are worthy of consideration. The human body constantly generates heat and must lose this heat if it is to maintain a constant temperature; *i.e.*, it carries on unconsciously a system of loss of heat by conduction, radiation and water evaporation. When there are other bodies in close proximity, and these are also giving off heat and water at the same time, as we find in a schoolroom, the process of heat regulation is rendered much more difficult than it would be in the open air. The result is that in crowded rooms, heat accumulation takes place within the body, which in

turn produces pathological symptoms, such as a sense of oppression, and even syncope. The experiments of Paul and Ercklentz in Breslau (Germany) have shown conclusively that with a high temperature (up to 30 degrees centigrade) and a high degree of humidity, the individuals in his test chamber soon showed these ill effects, while with a low temperature (below 20 degrees) and average humidity, such symptoms were altogether absent, even after two hours' stay in this atmosphere, notwithstanding the fact that in both cases the carbon dioxide content of the air was greatly increased—in the first instance to 13 per 1,000, and in the second as high as 16 per 1,000.

Hence it is clear that for general school conditions the temperature of the classroom should not be above 20 degrees centigrade, at which temperature the body can carry on its processes of regulating heat most effectively. But even when the temperature is kept at the recognized standard, occasional thorough airing of the classroom should not be regarded merely as a secondary need. The increased carbon dioxide in the atmosphere decreases the exchange of air within the lungs. The work of the lungs is therefore lessened, especially as the children remain inactive. As the children sit quietly at their desks, they are constantly breathing in a good amount of the air which has just been exhaled, because respiration for all of them is on practically the same level within the room. For this reason we need fresh outdoor air.

The presence of poisonous substances in expired air has not indeed been conclusively proved, although the

investigations of Helwig of Zinnowitz (Germany) have shown that the bad air of unventilated, crowded rooms seems to have an influence on the red blood corpuscles, giving the cells an appearance of undergoing degenerative changes. These characteristics of the red blood cells are not present under favorable conditions, *i.e.*, after bodily exercise in the open air. The investigations of Lobsien in Kiel (Germany) have likewise shown that breathing exercises have a favorable influence upon mental activity.

As has already been mentioned, it is undesirable for children to sit in the schoolroom before the beginning of the session, when they can move about in a recreation room, or better yet, may be exercising outdoors, as has become the rule in England.

Dust.—Dust is another source of air deterioration and one which is being increasingly recognized. It is not well to keep children sitting for a long period of time, and yet when they move about the room they must stir up dust; for this reason, again, they should not come into the classroom long before school. Rooms must be cleaned and aired as often as possible; the air of even a clean room holds hundreds of organisms, while a dirty room contains hundreds of thousands to the cubic meter. The evil conditions that exist in many classrooms, so far as the presence of dust is concerned, have been brought out by the numerous investigations that have been made. Meyer in Leipsic, for example, found that with taking particular care to keep the shoes dusted, the quantity of dust which had accumulated from one bi-weekly sweeping to another equalled 191 grams in dry weather and 327

grams in rainy weather. Of the swept-up dirt a large part sinks to the floor after a quarter of an hour, but the finest dust requires from half an hour to an hour and a half to settle. In this dust disease may lurk.

It is a noteworthy fact that many hygienists who investigate the dust problem select the school as the most productive breeding place. From what has been said about the relatively long suspension of the fine dust particles in the atmosphere, it follows that dusting of furniture should not immediately follow sweeping, and also that the sweeping (which should never be dry) must not be undertaken shortly before schooltime.

Airing.—It is clear that the airing of the schoolroom bears an important relation to the health of its occupants. To have a constant interchange of air in the classroom would necessitate so large an accession of fresh outdoor air as to make the movement of air in the room plainly perceptible. This is mostly the case with artificial ventilators, and for that reason they are not always practicable. In the dwelling house with its relatively small number of occupants, conditions are different; there untight windows and doors often create unobserved channels of air. Even an unused stove and porous walls in themselves are ventilating agencies, which can be only slightly effectual in the case of the school.

Direct airing is admirable, and can be readily achieved by opening doors and windows while the children are sent into the corridor. In cold weather a rapid exchange of air takes place in consequence of the difference of temperature. The air does not

contain much heat, whereas the furniture of the room and its walls contain on the average about 1,000 times as much heat in the same cubic space; the room loses very little of its stored heat during a minute's exposure to the cold and a minute of thorough airing, or even half a minute, suffices in very cold weather to effect a renewal of air. If the heating is good, the remainder of the recess time of say a dozen minutes will be sufficient to warm the air; the breathing of colder, fresher air in a room where the walls and furniture are still warm does not jeopardize the health. Valuable experiments with this simple method of ventilation have been carried on by Dankwarth and Schmidt of Dresden.

Ventilation.—During the summer or in warm weather, the windows of the schoolroom can well be left open if the situation of the building warrants it, but in cold weather artificial aids to ventilation are necessary. The best is the so-called mechanical ventilation, that is by means of an apparatus worked by motors. This type of ventilation is practicable where the power, *i.e.*, electricity, is not too expensive. It is being used extensively in the United States, even in small schools, and also here and there in the higher schools of Europe. As has already been mentioned, this method of ventilation is in use in the Drontheim pavilion school.

In all artificial ventilation to bring in fresh air is preferable to taking out vitiated air by suction, for in the latter case the source of the incoming air is questionable.

Even a small school can have its ventilating system

and, if the directions for operation are to be found posted conveniently in the schoolhouse, there should be no trouble in management. One method is to have an air pipe, leading say from a garden, where the best air may be had, with the opening protected against mice and cats by a screen. This air pipe (L. Figs. 14 and 16) enters a stove, or more correctly speaking, enters between the stove and its outside casing or mantle, where the cold air becomes warmed, and then flows into the room. The heated air being lighter naturally rises in the room and constantly replaces the colder strata. The used air in the room which is colder sinks and escapes through an opening in a corner near the floor (W, Fig. 15), *not* near a pupil's desk. This opening leads to a conduit going to the roof, where the used air finds an outlet. Of course, in summer the conditions are reversed; the clean air is then the cooler air, and the opening for the escape of the used air should be near the ceiling (S, Fig. 15). This vent (S) open in summer should be closed in winter when W is in operation for the exit of used air.

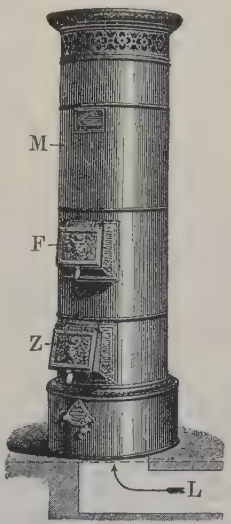

FIG. 14.—The Meidinger stove.

This method of ventilating by means of temperature differences unfortunately has its weak side. It works

admirably in severe weather when the temperature contrasts are sharp, sometimes too well, because so much air comes in, that the opening will have to be closed to save using so much coal; but when little heating is required, the amount of fresh air admitted by the ventilator will naturally be correspondingly small. Moreover the upper vent (S) is of use only when the air of the room is warmer than the air outside. It might be possible during warm weather to warm the air in the conduit which carries out the foul air by means of a gas jet or a lamp, thus aiding the

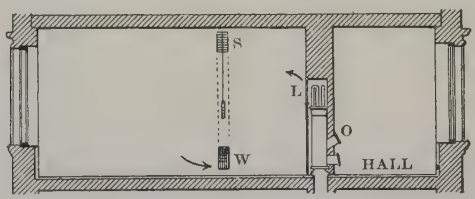

FIG. 15.—Ventilation by temperature differences.

process of air exchange. Since the air in summer streams in at doors and windows, the ventilation canal L (Fig. 16) could be dispensed with entirely without spoiling the air of the room, for if it were open it would simply admit air which would immediately escape through S, without circulating in the room. Scientific ventilation demands that the air in dusty places shall be filtered.

Heating.—The essential requirements of all school stoves are that they shall be safe, shall not give too much heat, shall warm quickly and evenly, and be an aid to ventilation, not a source of bad air. To avoid the latter possibility, care must be taken to see that

no part of the stove, including the oven, becomes too hot, for overheating causes deterioration of the air through action upon any dust which may fall on the stove or which may linger in the atmosphere about the stove, as has been demonstrated by Nussbaum in Hanover (Germany) and by von Esmarch in Göttingen (Germany). This deterioration begins at a temperature of 70 degrees centigrade.

Stoves.—Of the many different kinds of stoves adapted for the schoolroom the Meidinger deserves description. Figures 14 and 16 illustrate its construction. There is a cylindrical body with a firebox, Fu, composed of skeleton iron rings, a neckpiece H, with a door, the opening of which can be regulated laterally to control combustion, and which can be opened from above like a lid for the removal of ashes. The coal (egg or small coal) is put in at F and lighted while Z is open. When the coal burns F is to be closed and Z opened laterally to regulate the heat as it is wanted. M and M′ are the tin casings between which the warmed air ascends; if the vent S is closed,

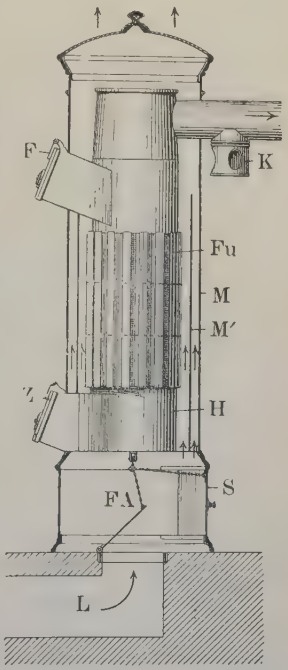

Fig. 16.—The Meidinger stove, interior view, showing ventilating system.

FA will be open and fresh outdoor air then comes through the conduit L; this air circulates in the space between the stove and its casings. If S is opened, then the door FA closes the conduit L and only room air circulates between M and M′, *i.e.*, there is no ventilation whatever. This latter procedure, therefore, should only be undertaken before or after school hours; in very cold weather the regulator Z may be almost wholly closed after school session, leaving only a very small slit-like opening so that the fire may burn the whole night through. This will insure a warm room in the morning, with a minimum consumption of coal. K is a little ventilation box which when open sends the air of the room directly into the chimney. This practical ventilating stove, which never needs cleaning for soot, may also be so placed that the firing and ventilation can be controlled from the corridor, as shown in Fig. 15, with the advantage that no fuel or ashes need be brought into the schoolroom. In that case, the outdoor air comes in through an opening in the outside wall, as shown in the plan, and enters the room at L (Fig. 15). To secure good management of the Meidinger stove, the directions for its operation should be easily accessible. Where the heating is by stoves, care should be taken in planning the school building to have a separate chimney for every stove.

Gas Heaters.—The advantages of heating by gas have of late brought this method into popularity even in schools. The advantages are, cleanliness, convenience, and the ease with which gas heaters may be regulated as well as started and shut off; but,

on the other hand, the cost of gas heating is often prohibitive. The ordinary gas stove used in the home is not adapted for the schoolroom, but a number of specially constructed heaters exist, all based on a special scientific principle. The attempt should not be made to introduce gas heating into old schoolhouses. Gas heating requires special, very narrow chimneys (10 centimeters wide) and the walls of

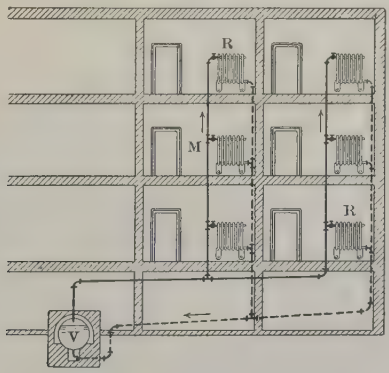

FIG. 17.—Steam heating.

the chimney must be constructed of building materials especially adapted for this purpose, as the combustion of a cubic meter of gas generates somewhat over one kilogram of water in the form of vapor which contains corroding chemical substances. With the old, wide chimney there is a possibility of the vapor settling on the walls, saturating them, and in combination with other products starting disintegrating processes in the chimney.

Central heating by steam or hot water is the most practicable system for large schools.

Steam Heating.—The principle of low-pressure steam heating is illustrated in Fig. 17. There is a boiler (V) in the cellar, from which pipes (M) lead to the various rooms, and radiators (R) give out warmth in the rooms. When the steam has again been precipitated into water, it descends by means of other pipes (broken line). It is also possible to elaborate this system into the low pressure hot-air steam heating by using the steam from the boiler in the cellar to warm a big heater which receives fresh outdoor air through a vent, warms this air and sends it by conduits to the rooms. In particularly cold rooms, separate heaters, all supplied from the same boiler in the cellar, may be set up. This system has replaced the old-time hot-air heating, which possessed the disadvantages of carrying, in addition to the warmed air, various gases generated by the burned dust, and when the brickwork of the furnace became loosened, also smoke into the room. Ventilation, however, is nicely secured in the case of low pressure steam heating by means of fresh-air conduits which bring the air from out of doors directly to the registers, where it is warmed and sent off into the rooms. This plan does away with the old difficulties experienced with the combined hot-air heating and ventilation.

Hot-water Heating.—The requirements for hot-water heating are similar to those for steam. As shown in Fig. 17, the water is heated in the boiler, it ascends by pipes to a tank on the upper floor,

goes from there to the rooms, giving off warmth, and sinks back to the furnace. The advantage of the hot-water system is, that the radiators retain their heat longer than with steam heating; but the cost of installation is higher, and there is the possibility that the water in the pipes may freeze in winter, especially during the Christmas vacation. Recently a device has been invented for the more rapid circulation of the water in the pipes.

One point in connection with central heating is important; there must be no niggardliness or stinting in installation. Furthermore, the person in charge of the heating should be competent and intelligent, permanently employed, not one temporarily engaged who is obliged to seek other work in summer. Better employ a man the whole year, in summer time for cleaning in the schoolhouse, and engage a new person for cleaning purposes in the winter. To achieve the best possible management, the heating and lighting arrangements should be subject to the direction of one who can give intelligent and expert supervision, as for instance, the instructor in physics. The comfort of the school population depends upon properly managed heating, lighting and ventilation, and the significance of these from the standpoint of health is paramount.

4. The Classroom and Its Equipment

Much of what has been said before underlies, reinforces and will be repeated to good purpose under this heading. The whole question of classroom arrange-

ment is so involved and interactionary that it is not always possible to isolate and discuss separate aspects of the problem.

The most serious hygienic consideration with regard to the school is this, that a relatively large number of individuals must be confined for a considerable period of time in one room. When we ask, what shall be the size of that room, the answer hygienically considered must be, the larger the better, because of the better air. But practically, the size of the classroom is determined by the following conditions: the carrying capacity of the instructor's voice, the distance at which the desks can be placed from the blackboard, and the number of pupils which a teacher can instruct. The width of the room is controlled by the amount of light which penetrates to the farthest desk. The greater the width, the higher must be the ceiling, but the higher the room, the more difficult it will be to heat, and the greater will also be the cost of construction.

Size of Classroom.—Considering all these conditions, it is safe to conclude that a classroom 9 meters long, 6 meters wide, and 4 meters high, is most practicable. In a room of these dimensions 50 pupils can be seated in good-sized, two-seated benches (cf. p. 89, also Fig. 18); that is really a large number and a greater can not be accommodated with comfort. Unhappily, conditions as we frequently find them lapse far below this ideal, to the detriment of teacher and pupils. In many highly cultured communities, matters of expense and equipment are still patterned after the demands of a time which included no hygienic

considerations. It is not always possible to reconstruct; hence it can not be too emphatically urged that in young communities which are still in the period of forming and developing their school systems, these matters should receive careful thought, in order that

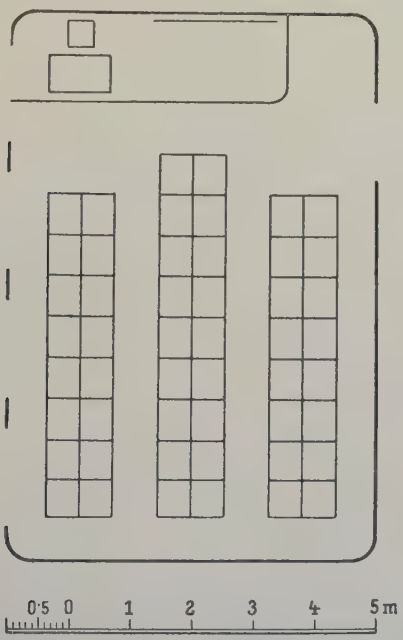

Fig. 18.—Plan of a schoolroom with benches each accomodating two pupils.

sufficient funds may be appropriated to carry out such hygienic plans.

The most desirable ratio of length to the width of the schoolroom is 3 : 2. Of course, the limit of 9

meters for the length of a room applies only to classrooms where the voice of the speaker plays the important rôle; it does not hold for rooms where drawing is taught or for gymnasiums, where height and width are more, or at least equally important.

Walls and Ceiling.—All corners, those of walls and ceiling, walls and the floor, should be rounded, in order to facilitate cleaning. The walls should be tinted a neutral tone, preferably a light green, the upper third whitened to augment reflected light, and the lower section, about $1\frac{1}{2}$ meters from the floor, finished in a durable material, for instance in tiling, as is done in London schools, or in cement, which may be painted with oil paint. The ceilings should be pure white. A preparation can be used for disinfecting the walls that is said to retain its efficacy for a considerable period.

Floor.—The floor should be durable, well joined, not dust retaining, and easy to clean. Soft wood is to be condemned; it splinters, gets into the mops, and is a continual harborer of dust. Hard wood should always be chosen. Prepared beech wood and American pitch pine are to be recommended; they are cheaper than oak, which, of course, is the most durable of all. When laid in the usual mosaic pattern these woods will give good wear. If the floor planks have joints which do not fit tightly, the yawning places should be scraped and trowelled with a mixture of fresh curds and slaked lime in the proportion of five to one. The result is a casein cement with lime, which is as hard as stone, and impermeable to water. Any coloring, for example, ochre, may be added.

Unless this is done, the openings will harbor moisture after every cleaning, creating a situation favorable for the breeding of bacteria and vermin.

Ordinary wood floors require surface treatment. The cheapest way is to have the floors thoroughly washed and dried and then painted with a thin coat of coal tar. This tar can be procured at any gas plant and can be applied after warming over a gentle flame, not more than 40 degrees centigrade, and since it must have that temperature when being applied it is best to keep the vessel during use in a kettle of water at 40 degrees. As the tar retains its odor for some time, the work should be done during a school vacation. The oiling of floors is to be recommended, for good specimens of dustless oils have proved effectual in holding down the dust, which the movements of the children otherwise keeps in circulation. In cleaning, the dust is swept into little balls by means of a hard broom. The oiling must be renewed three times a year or oftener if there is a great deal of dust. But notwithstanding the great hygienic value of oiled floors, they are not popular with women teachers who wear long skirts. This nuisance to the teachers could be avoided in some measure if a definite area around the teacher's seat were left free from oil. Again, footprints show very easily on the clear surface of the corridors. Because of these drawbacks, floor coverings such a Xylolith or linoleum are sometimes chosen. Xylolith would serve the purpose well for it is able to withstand wear, but it is not a good conductor of heat and therefore makes the floor too cold. Linoleum, which is a mixture of cork and oxydized

flaxseed oil with resin and coloring matter added, makes a very good floor covering, but it is expensive and it requires care: the padding underneath must be very smooth and quite dry and the linoleum, which should be of a good firm quality, must be absolutely dry before it is laid.

The School Desk.—The bugbear of school hygiene for a long time has been the school desk, or the desk form, as it is called in England. Naturally, the first requirement is that the desk shall be adapted to the user and yet allow him a good deal of freedom in movement. The child must be able to assume a freer posture in reading than while writing, when he must necessarily be in a somewhat cramped position; he must be able to stand up and sit down with comfort, to get in and out without difficulty. These matters are of prime importance. But the attempt to enforce good posture solely by means of the school desk must be abandoned at the outset. The desk should not have sharp corners, which may cause bruises. It should be such as not to render cleaning difficult, nor should the forms be of a shape to interfere with the teacher's vision of the pupils, and lastly, the desks should be practically noiseless. After conforming to these requirements, it is essential that the desk form does not take up too much room, nor must it be too expensive.

To maintain a sitting position for a long period of time is in itself unhygienic, particularly for children; to sit long in an upright position requires constant effort, even for adults, and the difficulty is increased when the child is sitting on a bench which is not suited

FIG. 20.—Moulthrop movable and adjustable school chair, Model B, manufactured by Langslow, Fowler Co., Rochester, N. Y.

to his height. In consequence, he is obliged to assume positions which can not fail to be detrimental to health, *i.e.*, the development of the thorax is hampered and there is interference with respiration, circulation of the blood, and digestion, besides possible injuries to the spine and the eyesight. It should be the serious aim of the school never to be the cause of any such injuries to health. To overcome the difficulty of long sitting it has been advocated that alternate sitting and standing be the rule in school, and certain types of German, French and American desks (cf. Fig. 20) which can be readily converted from sitting into standing forms are available. But long standing is even more fatiguing than sitting, and is not to be recommended. Fig. 20 has a sliding desk top which can be pushed aside at will, thereby allowing the child to stand immediately and without difficulty.*

Let us assume that a new schoolhouse is to be built on the site of an old one. In order to have the new desks of the right dimensions, the children of all classes ought to be measured before the desks are ordered, and the new school furnished with desks of various sizes to fit the children. At the beginning of the next school year, the previous assortment of desks in the rooms will probably not answer the purpose very well, the assortment of children will be different each year and there may not be as many children of a certain size as there were in the previous year. If one mixes them again in the second half

*This model, the Moulthrop movable and adjustable school chair, is made by Langslow, Fowler Co. (United States), and is indorsed by Madame Montessori in her school methods.

year and compares their sizes with the various sizes of school desks, it will be found that a number of children in the age of rapid growing have grown out of their standard of desk. Even in small country towns the desks of the school should certainly not be ordered before the children have been measured, and if possible, measurements should be made at the beginning and the middle of the school year. Unfortunately the selection of the desk sizes is frequently left to the manufacturer.

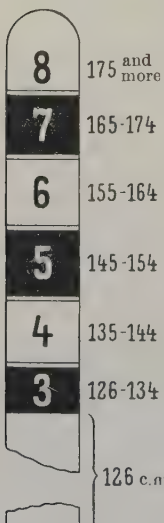

FIG. 19.—Measuring rod numbered for the various sizes of desk forms.

Under favorable conditions a half yearly measuring of the school population and seating according to the results found is excellent; it is a convenient, easily to be obtained, and from the point of view of health a reasonable exaction. The work can be done very quickly by means of a measuring rod, which the author described in 1896 and recommended for manufacture. Fig. 19 shows one of these rods designed for use in the schools of Vienna. The measuring stick must have divisions marked off for the various sizes of desk; the teacher records opposite the name of the child the corresponding size of the desk. Dufestel of Paris has constructed a measuring stick which automatically records the height of the pupil in millimeters.

If it is found that in one classroom there are desks

FIG. 21.—The "Princeton" adjustable desk and chair, manufactured by The New Jersey School-Church Furniture Co., Trenton, N. J.

which do not fit the children in that room, the desks should be exchanged for others obtained from other classrooms.

Adjustable School Furniture.—The ideal desk is one with adjustable parts and which can be fitted to the child. Such single desks (Fig. 21 and 22) are used in many schools in Great Britain and the United States; or where their exclusive use is not prescribed, the requirement is made that at least one-third of the desks in the new school shall be of this type. Adjustable school furniture has also begun to be introduced in Germany, and is being used in a small number of schools in conjunction with the older type of desk.* Desks which can be adjusted without a screw or key (Fig. 22) are better than those for which an implement is needed. One of the oldest adjustable desk forms is that put on the market by Hansen in Copenhagen; it has a movable foot rest to adjust the height of the seat to the body of the pupil, and a movable back to adjust the "difference" and the depth of the seat. This type of desk has given good service in a number of schools of Denmark and received high commendation in a report of the Danish school health commission (1884).

In secondary schools, where the classrooms are not always used for the same grade in succeeding years, or in schools where they are made use of for different purposes—for adult evening classes, assemblies or for

*Adjustable desks are produced in Germany by Elsässer, Fuhrmann & Hauss, Kottmann, Lickroth & Co., Zachokke; in the United States by the New Jersey School-Church Furniture Co., the American Seating Co., and others.

entertainments—the adjustable desk is by far the best, especially if it can be quickly arranged. A new model from a London manufacturer is made of wood, is adjustable by means of springs in the legs of the desk and bench, and is arranged so the top can be pushed away or brought nearer to the body. The correct height of desk and seat can be secured very simply by pressure upon the spring and then raising or lowering the parts in question. When a desk of this type is used, there is no need of taking measurements and notes; the older children especially do not require much instruction in adjusting, with the help of a fellow student, the desk and chair to suit them. The charm of newness which makes the pupils want to play with these adjustable desks will not last long; children do not want to play with ventilation valves or windows or doors although these things are movable too. This difficulty will be lessened if the children are not admitted to the room before beginning of class nor during recess periods when the teacher is not present.

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Aside from these and other newer desks, the non-adjustable desk forms are used a great deal in Europe, and from three to ten different sizes may be procured. There are hundreds of models on the market. When the desk can be found in a greater number of sizes, say from eight to ten, it is easier to choose a more fitting size for the body than if there are only three sizes of desks, but the practical difficulties experienced with so many different sizes are increased. If a teacher has a room with desks of different sizes which are not bought after the above described meas-

Horizontal Adjustment of Top at will of occupant.
Adapted to varying uses.
The only scientific and practical Plus and Minus adjustment.
Top has Horizontal Adjustment of 3½ inches.
Inkwell exposed when top withdrawn for writing; covered and protected when top returned for study.
Vertical adjustment of Back Support 2⅛ inches.
Not adjusted by occupant.
Affords proper support to back and correct position.
Vertical adjustment of Desk Box
No. 1. 32¼ to 27⅝
No. 3. 27⅝ to 22⅞
No. 5. 24¼ to 19 7/16
Not adjusted by occupant
Vertical adjustment of Chair Seat
Top of Seat from Floor:
No. 1. 18½" to 15"
No. 3. 16" to 12½"
No. 5. 13½" to 11"
Not adjusted by occupant

AMERICAN STEEL ADJUSTABLE BOX DESK WITH SLIDING TOP
CHAIR EQUIPPED WITH ADJUSTABLE BACK SUPPORT

FIG. 22.—Adjustable desk and chair, manufactured by the American Seating Company, Chicago, Ill.

uring of pupils, nothing can be done but to distribute these desks according to their dimensions, form the pupils in a row according to their height, and seat them in that order in the desks. Special attention must always be paid to the nearsighted and the deaf. The resulting arrangement, the best possible under those circumstances, is naturally not always satisfactory.

Desk Dimensions.—It only remains to say a few words about the constituent parts of the school form and their relations to one another. The seat should be just so high from the floor that the upper part of the leg is horizontal and the lower part perfectly perpendicular when the foot is placed firmly on the floor. If the seat is too high, the nerves and blood vessels on the under part of the thigh are compressed, particularly those near the edge of the seat, and the child is apt to slide forward and to lapse from the erect posture. If the seat is too low, the thighs will be pressed against the abdomen. The depth of the seat, *i.e.*, the distance from the forepart to the rear, is influenced by the length of the thigh; the depth must be such that the child's back reaches the back rest, a support of two-thirds of the thigh is amply sufficient. The position is firmer when the seat is slightly curved as shown in Fig. 23.

The level of the desk top should be in the plane of the sitter's elbow when the arm is hanging down. If the top is too low, the child must bend down to write, assuming a position which is injurious to the spine, the chest, and to the respiratory and digestive organs. If the desk is too high, he uses his eyes too near the

work, and the arm can not be held near enough to the body when writing. The question of the tilt of the desk will be considered later.

The back rest is absolutely necessary because a child can not sit for any length of time without some support. The rest may be of various heights, but it should at least support the lower third of the spine. At this point we reach a real difficulty, for if one surveys classes of children in a school, one notices how seldom the back of the seat is used as a support. The fact of the matter is that a back rest is comfortable only when tilted backward to a considerable degree, as in an easy chair; but if this were done in the schoolroom, the seat must also be tilted correspondingly (Fig. 23) in order to insure firm seating. Furthermore, the desk would then have to be tilted, otherwise there would be a strain on the eyes, for a great angle of vision is unbearable, while one of about 8 degrees requires no strain whatever. When reading, the pupil may hold the book in his hand, that is, in a tilted position; but in writing the tilt of the desk can not be so readily adjusted. The desk top can not be tilted too much, otherwise the arm must be held in such a way that the ink will not run from the pen. This would be very tiring

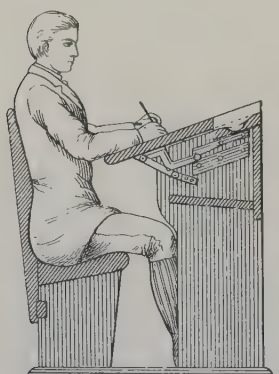

Fig. 23.—A desk designed by A. Lorenz.

to the arm, even for a short time, but should there be no possibility of change it would be unbearable. The tilt of the seat involves many other problems. The best back rest has a uniform slant. Orthopedists formerly recommended a projection to curve into the lower part of the back, until Schulthess of Zürich showed that in a sitting posture the natural curves of the spine are not as pronounced as in stand-

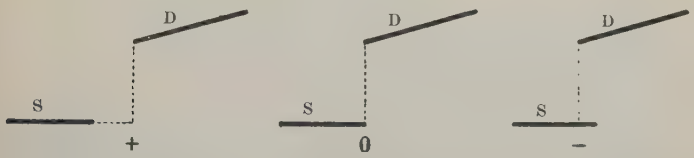

FIG. 24.—Distances between seat and desk. S = seat, D = desk. The cut to the left shows plus distance, the middle null distance and the one to the right minus distance.

ing. Recently, Piesen of Prague has shown that this wooden projection may do absolute harm to children; in a number of children so placed albumin was occasionally found in the urine. However, a back rest is absolutely needed for the support of the lumbar region of the spine.

If as in Fig. 24 a perpendicular dotted line is dropped from the edge of the desk (D) to the floor, this line will meet the edge of the seat (S), or go to either side. This dotted line constitutes the "distance." It is immediately clear that what is denoted as "plus-distance" is bad because it demands bending forward during work, while the "minus-distance" is the proper one for writing, but restricts the movements in other

occupations and prevents the child from standing up. To meet this difficulty, distance adjusters have been designed in order that the bench can be so placed as to permit the child to write at minus, and to sit at plus distance from the desk; the latter distance also permits of easy standing up and ingress and egress. The value of a school desk is greatly increased by these distance adjusters; schools which are putting in new

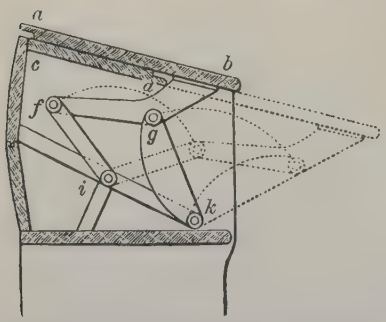

FIG. 25.—Movable desk top by Schlimp. For writing it is inclined in the dotted line *a, b*; at other times it is in the line *cd*. The change is made easily and noiselessly by the joints, *f,g,k,i*.

FIG. 26.—A readily adjusted seat designed by Schenk.

furniture should install only desks so equipped. The distance may be adjusted in various ways; the desk top may fold on itself (Fig. 27), or it may be pushed forward or backward (Fig. 23), or drawn out and pushed back again (Fig. 25);* or the seat can be turned up and put back, or moved forward and backward like a pendulum (Fig. 21 and

*A model possessing distance adjusters in the desk is shown in Fig. 25. It was invented by Schlimp Brothers (patent expired), and is much used in Austria. It is one of the many modifications of the original adjuster designed by Kunze.

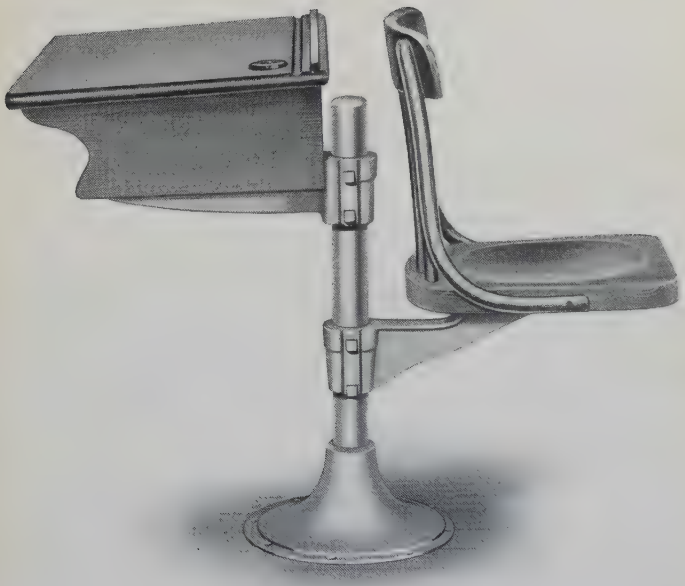

FIG. 27.—Single pedestal desk combination, manufactured by Kenney Bros. & Wolkins, Boston, Mass.

26). The seat adjustment merely makes room for the pupil to rise, but does not influence the sitting distance. It is essential that these adjusters should be tolerably noiseless and also that they be of such construction that they do not act as traps in which the hand may be caught and pinched. An adjuster like Fig. 25 has the advantage that the pupil when writing can easily set the desk at minus distance, and during the writing pauses can push the desk away from him for greater freedom in movement.

But still the "distance" referred to above does not entirely solve the question, the really significant distance being that between the slanting back rest and the desk edge. For writing, this space should be a few centimeters greater than the body thickness at the chest; it should correspond to the length of the forearm.

The low desk forms of small children are a tax on the teacher, who must bend over to see the work. For this reason such desk forms should be placed on a pedestal or the form should be quite high, with a footstool to make the child comfortable. The footstool has a disadvantage in that if the desk has no movable "distance" and the child wishes to stand for recitation he must first step out. Experience shows that this inconvenience frequently results in the teacher not requiring the pupil to rise, and the child thus loses the opportunity for exercise gained by the change of position—a distinct disadvantage from the standpoint of hygiene.

In the non-adjustable desk forms each desk should be attached to its own chair, not a chair to the desk

behind, so that when shifting the furniture a chair will always correspond to its own bench. It is better to have non-adjustable desk forms which accommodate but two pupils, for with desks accomodating only two, each pupil can step in and out, and the teacher can pass each place—a condition which does not hold for forms accommodating more than two pupils. The use of desk forms accomodating not more than two children has been prescribed by law in Sweden since 1878.

Movable Desks.—To facilitate the cleaning of the floor, many ways have been suggested and one of these is to make the points of contact of the desk with the floor as few and as small as possible (Fig. 27). The idea has been developed in the United States and in France since 1877 under the "Mittelholm" principle. In some places double-seated desks were merely turned over at cleaning time; this was first done with the Roux desk in 1887, in the Villamont School at Lausanne (Switzerland), and is still done in many other places. In 1893 Rettig patented a movable desk (similar to desks shown in Fig. 28) and in 1900 Zollinger of Zürich introduced the idea of having whole series of desks on casters, so that they can be readily moved out of place. Different sorts of appliances for rolling the forms have appeared in Switzerland, Austria and Germany. One plan is to have the rollers of the desks coupled together (Fig. 29); another plan, first suggested by Baudin of Geneva, is to have a whole line of desks on an iron rail (∩) in which the rollers are set (Figs. 30 and 31). This plan of rolling away the benches when cleaning the floor is decidedly the best,

FIG. 28.—Benches (Urania) designed by Piasecki, turned over for cleaning the floor.

for with a clean sweep of floor there are no inaccessible places. It is easier to push the tiers to one side than to turn one desk over the other, at the same time there is no danger of spilling the ink, although the reversible desks do have special inkstands which when carefully handled can be turned over also. All kinds of desks with movable parts are better pushed than turned over; furthermore, iron desks also can be rolled but they would be too heavy to turn.

The question as to the injury which such roller benches may sustain from the children playing with them has already been raised. The author personally does not knowof any such instances though he has inquired concerning this point in places where such desks are used. The outer edges of the large projecting rollers (Fig. 29) should be rounded off so that the floors will not be scratched. At the Dresden International Exhibit a contrivance* was shown whereby the benches when in use stand without rollers, but are readily put on rollers at cleaning time.

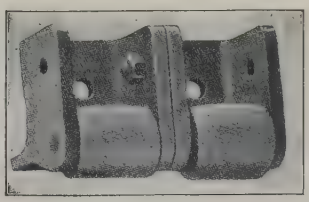

Fig. 29.—Rollers coupled together for rows of benches, designed by Walter.

When three tiers of benches are pushed away, a large floor space for exercise can easily be had (Fig. 31); this would be impossible with stationary benches, or those which can only be turned over. In the United States gymnastic apparatus are arranged on rollers in a similar way.

*This contrivance is manufactured by Lickroth & Co.

Posture.—Associated with the problem of seating is that of a correct sitting position. Where a schoolroom is equipped with practicable desk forms, a hygienic posture should be urged upon the child from the outset. A definite amount of time should be allowed for acquiring a good position at the desk. Beginners, for instance, should not be required to assume the correct writing position for more than a fraction of an hour, being permitted during the remainder of the time to assume an easier attitude, for to maintain a correct posture means considerable work for their muscles. Parents can help by admonitions at home and also by purchasing the right kind of a house desk which the shops offer in a variety of forms, or proper provisions can be made by means of a footstool and an upholstered chair. Many mechanical means have been designed for helping a child to maintain an erect posture. The subject can not be discussed here in full, but mention should be made of a device sold by Iberg in Basel. This is the *Brillengeradehalter*, a spectacle frame with two black celluloid flaps, which fall down over the eyes when the pupil bends over, but which adjust themselves and uncover the eyes when he straightens up. Another useful and inexpensive device is that introduced in the *Guts-Muthsrealschule* of Quedlinburg by H. Lorenz. It is a light metal ring, about 20 centimeters in diameter, which slips from the head of the child when he tilts his head too far forward or too far to one side. The term *Geradezwinger* (upright forcer) does not convey a pleasant meaning, and its use would be objectionable if the teacher should forget

FIG. 30.—A schoolroom in Geneva with three rows of two-seated benches designed by Mauchain. The benches are placed on the Baudin rollers.

FIG. 31.—The same room as shown in Fig. 30. The rows of benches have been moved close together, to give a large free floor space.

to pay attention to the fact that the child can only bend his head forward a short distance, and the contrivance may overtax the child's back and neck muscles.

Blackboards.—The blackboard should be of a dull finish, not too highly polished, and so placed that in looking at it the children will not be dazzled by light from a window. Large shiny blackboards on the wall opposite the windows are likely to take away much reflected light, as has been shown by Gstettner of Vienna, therefore dull ones would be more suitable. An antiseptic blackboard, which resembles an oilcloth scroll, has recently come into favor in New York City schools.

Lavatory.—If the children use chalk they should have a place where they can wash their hands. It is most desirable to have the lavatory in another room, in the cloak room, the recess room, or the toilet, as has already been discussed.

Expectoration Receptacles.—The question of disposing of the expectorations of the children is a more difficult one. Covered cuspidors attached to the walls are better than those placed on the floors. It seems hardly necessary to say that expectoration on the floor should never be tolerated. Children who have to expectorate should be placed near the cuspidor, so that when necessary they can step to it without causing a disturbance. Since Dettweiler devised an individual saliva cup, many others have been suggested. The question whether it would be better to provide these for the coughing pupils or to require the parents to furnish them for their children is no difficult

matter to decide by experimenting; but a highly cultured public is generally disinclined to discuss matters of this sort.

5. Other Rooms, Grounds, and Facilities of the School

Gymnasium.—From the standpoint of hygiene the gymnasium is most important. It must be well lighted, convenient, easily ventilated and suitably heated. It should not be located in the basement. The apparatus must at all costs be safe and the wood work should not splinter, for serious injuries or even fatalities may result from neglect of these requirements. To see that such matters were attended to, in 1895, the government at Sigmaringen (Germany) ordered a yearly inspection of gymnasium apparatus. The greatest problem existing in the gymnasium is the presence of dust. For this reason, the children should not be allowed to enter in their street shoes, nor should the mattresses in the gymnasium be allowed to become dust receptacles, which is hardly possible to avoid with cheap kinds.

The floor covering must be good (for instance, strong linoleum), and not slippery. The use of floor oils has been decided against by some teachers though it is not generally objectionable, for the gloss will disappear after once using the floor and the oil when thinly applied can hardly be a source of danger. It is to be recommended that in winter when much dust may be brought in and no precautionary measures for its prevention are taken, those exercises which would cause a dissemination of the dust be omitted. The author has had occasion to inspect a new gymnasium

in a large city where no oil was used on the floors and no special shoes were worn by the children, and where such unhygienic conditions existed as to make the work in the interest of preventing tuberculosis a derision. This state of affairs in gymnasiums is all the more remarkable since von Pirquet has proved that a very high percentage of children is infected with tuberculosis, even though the infection seldom reaches a dangerous stage. The question, then, may well be asked—how can a teacher manage to keep the room free from dust, when the streets are dirty and oil is not used on the floors, and no change of shoes on the part of the children is required? Even when care is taken to wipe the shoes at entrance, it is impossible to exclude all dust. In view of this fact, it seems neglectful to do without floor oil.

The gymnasium should have its own cloak room, a convenient, indoor toilet, and if possible, its own lavatory. Physical exercises carried on in the open air are preferable to work in an indoor gymnasium, for conditions in the open air are better adapted to meet the increased demand made upon the lungs. Hence, an open-air gymnasium situated in the school grounds partly roofed over, but open at the sides, is ideal for this purpose. In a large school, when choosing the site for this outdoor gymnasium, it should be remembered that close proximity to the classrooms may disturb the work of instruction. Such details are all directly connected with the planning of the building.

Playgrounds.—In this connection the general problem of the recreation place comes up for discussion. The recreation room has already been briefly spoken

of and the indoor and outdoor gymnasiums have been mentioned in the preceding paragraph. In every case, a place in the open is very desirable where pupils can spend their free time when the weather permits and when waiting for school to begin. A playground should be as large as the available grounds permit; in small towns at least 5 square meters should be allowed for each child, and in even the smallest rural communities the total play space allowed should not be less than 200 square meters. In the most populous parts of large cities, the minimum should never be less than 1 square meter per child. The difficulty may be met in part by using the roof, as is done in London and New York. Fig. 32 shows the roof playground of a school building in New York as designed by Snyder. These roofs are used in that city on hot evenings as recreation places for mothers and children.

Where it is possible to have the yard large enough to be used as a playground and as an ice field in winter, for instance in the smaller towns, a good step has been taken toward the healthy rearing of children. In the crowded districts of large cities where it is not possible to have the playground next to the school, the aim should be to provide an open space elsewhere for the children of each school, one easily accessible by car lines at a minimum rate of transportation, plus a short walk.

The way of progress in the matter of the play of children has not been easy in Europe during the past generation. It is a long step from the epoch of the decree of 1882, effected by the Prussian Minister of

FIG. 32.—A roof playground on a New York City public school building, designed by Snyder.

Education, von Gossler, to the requirement of a definite afternoon per week set aside for play.

School Gardens.—A school garden, where it can be had, is to be recommended from the hygienic standpoint. It serves when next the schoolhouse to keep the air pure and affords opportunity for healthful outdoor occupation.

School Baths.—Among the many products of school welfare work, the school bath takes high rank, because of its hygienic significance. To the city of Göttingen (Germany) belongs the credit of having introduced, twenty-five years ago, the first school baths, an example which has since then been widely followed. The need for this extension of the field of education is shown by the following extract from a Göttingen report, "We state the shocking fact that with the exception of the face and hands, not a drop of water touches year after year the bodies of a great majority of the pupils in our German schools." Naturally, the argument is frequently advanced that these are not matters of the school, but rather of the home. It is an argument that needs constant refutation by the statement that very possibly in an earlier time the present and generally recognized right of the state to impose compulsory education, may have been regarded in the same light in which obligatory cleanliness is now viewed.

The school bath referred to above is the shower bath, which requires little room, and not much heating or water. It can be arranged that groups of children go to the baths at such times when a part of the class can be absent, for instance, during a penmanship

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period. The baths may be placed in a well-lighted basement and should have a dressing-room large enough to accommodate a number of pupils, who can undress while others are bathing. For the actual bath the water is first run warm (35 degrees centigrade), soft liquid soap is applied and the body is washed and rinsed in a temperature which gradually decreases toward 20 degrees. A bath of this kind requires five minutes of time, about 20 liters of water for each pupil and costs perhaps half a cent per person. The process is a rapid one—a new troup of children goes in as soon as the other comes out of the room, and undressing, bathing and dressing follow in quick succession. Thus a maximum amount of benefit is obtained at a nominal cost. The bathing should be done under the supervision of a teacher, and if necessary, an assistant might help the small children with their clothes.

The general practice with regard to these baths has been to leave it optional to a pupil whether or not he will avail himself of the privilege. The results have shown that while at first only a part of the children participate, in the end almost every one takes part. The school bath wins favor quicker when the children are encouraged, treated with consideration, and the rooms are comfortable. The practice of furnishing school children with free tickets for public baths falls far short of having the baths in the school. On the other hand, it is entirely feasible to permit the general public also to use the school baths. A separate entrance may be provided for this purpose, as has been done in some places. Such an arrangement might be

particularly helpful in rural communities, where children who have enjoyed the school bath could thus continue its use after graduation.

Swimming Pools.—Swimming pools and instruction in swimming are beginning slowly to be introduced into the public schools. Naturally this innovation depends upon the opportunities in this direction which the school possesses. It is encouraging to know, for instance, that from April 1, 1908 to October 1, 1909, 31,333 London school children were taught to swim in 60 of the public baths of that city.

School instruction in swimming can readily be imparted to large numbers of children by means of apparatus and exercises before the pupils enter the water, at least six such instruction periods being required. After these exercises the fourteen or fifteen year old children can be admitted to the tank, where they are held by apparatus, a whole row hanging on a cable stretched across the basin. Having then acquired skill in the arm and leg movements in the water itself, after two or three lessons they are permitted to swim freely with belts or other supporters, and under the supervision of a teacher. The "dry swimming" is practised in the afternoon gymnasium periods; later on these periods are used for swimming practice in the water. This practice has been introduced in different cities. In addition, in Germany, Austria and Switzerland there is school instruction in swimming under various other procedures, but the above-mentioned system will prove most valuable in teaching large numbers of children to swim. The rapid loss of body heat in the water, the increased

respiration necessary for swimming in consequence of the pressure of water, and the possibilities of ear difficulties, make a medical examination of the pupil a necessity.

Rooms for Domestic Science.—Other marks of modern development in the school are classes in domestic science and provisions for school feeding. Instruction in cooking, especially for older girls in the higher classes, occupies a prominent place in Scandinavian schools. The practice is also spreading in Germany, where it is being promulgated by the efforts of Auguste Förster, Kalle, Kamp and others. In England such instruction in the public schools is prescribed by law and the state contributes to the cost at the rate of four shillings per scholar. In London the dishes thus prepared are sold to the children, thereby making the establishment self-sustaining. These cooking classes date as far back as 1878. In the same city, in 1890 the first "washing centers" were established for school instruction in laundry work. In 1903 there were 142 such centers in operation. At the present time, the cooking, washing and other household activities are taught in small, easily accessible housecraft schools. Not every school in London has its own establishment, but a number of schools have access to a common center, convenient to all.

School Feeding.—School feeding may be instituted either for the benefit of children who live too far from the school to go home for the noonday meal, or it may be for the purpose of giving good food to very poor or neglected children. The arrangement made in the public schools of Paris is excellent. There the

children may have their luncheon (*déjeuner*) in the schoolhouse by presenting tickets, some of which have been paid for and some of which have been given gratuitously, and no one knows which child has paid and which has received charity. In some German cities also, in Munich for instance, provision is made quite as a matter of course for feeding the poorer children of the public schools. More than one-third of all German cities offer food in some way or another. The expense in such cases is usually defrayed by private benefactions, though there is a more or less definite tendency, especially in Switzerland, to regard it as an obligation of the state to supply sufficient and good food to the child who is badly nourished at home. The aim in many cities is to give aid where needed, and to ask for payment where the parents are able to afford it.

Toilets.—Both with respect to location and usage, the toilets of the school demand special hygienic consideration, as under adverse conditions they may easily prove a menace to health. Experience in school life, as well as a mass of statistical evidence, points out the need for improvement in this direction. In the first place, the school periods must be so arranged as to give the children recesses during which they may attend to their necessities, and in addition the children should be permitted to leave the classroom when necessary. Retention may often lead to harmful results, to maiming or permanent weakening of the bladder, to costiveness, as well as to sexual irregularities. In pubescent girls the increased flow of blood to the pelvic organs at certain times, accel-

erated by long sitting, creates a necessity for more frequent urination.

Unclean toilets may be a menace to the air of the schoolroom; unclean fluids from the toilets may contaminate the walls and even the drinking water. On the other hand, if the toilets are placed at some distance from the building, the children are in danger of taking cold when going to them in winter, especially

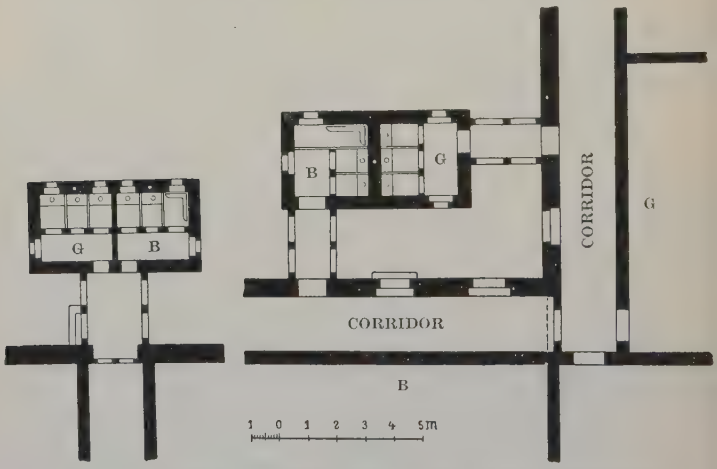

FIG. 33.—Location of toilets with entrances from the corridors. B = Boys, G = Girls.

the older girls at certain periods and delicate younger children, and there is always the possibility that children will not take the trouble to go to such toilets when necessary.

The dangers which spring from toilet gases in the rooms, and waste fluids penetrating the walls, have led to the demand that toilets shall be located outside

of the school building, which vastly simplifies the schoolhouse plan, though if we stop to reflect we must admit that no architect would think of placing in the yard the toilets of a two or three-storied dwelling house. Why then, should this location be absolutely necessary for the school? The fact is, that with the use of the modern improvements it is not necessary for the school, as has been shown long ago in Austria. There can be no objection to toilets on every floor of the schoolhouse, if they are located in an annex. Fig. 33 shows toilet rooms divided off from the corridor, one section for girls (G) and one for boys (B) with entrances from separate corridors.

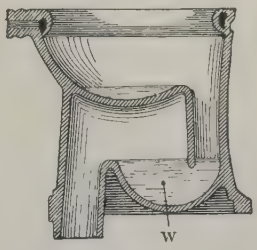

FIG. 34.—Siphon closet.

With a central water supply of sufficient pressure as found in large schools, detached siphon closets (Fig. 34) may be installed. These insure absence of odors, because not only is the waste immediately removed, but the standing water in the bowl (W) prevents the rise of sewer gases. At the commencement of the long vacation it is well to pour a little oil into the basin to prevent evaporation of the water. Where there are no sewers, the prevention of odors can also be accomplished by scattering saw dust into the pit after each use. But the whole matter of disposal of waste is so bound up with the conditions of the public removal of refuse in the locality in question that it is impossible to go into technical

matters here. The toilet rooms should be light, the walls of a glossy surface, so that they cannot be readily marked. The best way to accomplish this, though expensive, is to have the walls covered with glazed white tile, which is durable and can be washed. Where this is not possible, the walls might be plastered, the plaster laid in vertical grooves, after which the

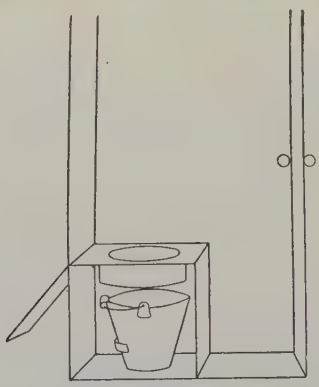

FIG. 35.—A closet for country schools, used in Maine.

whole surface is painted in a light color, care being taken to use no lead.

Where pits are the only receptacles for waste, it is necessary to have these quite apart from the building and constructed in such a way that the leakage of the waste is avoided. For building the foundation, hard bricks laid in cement or asphalt are to be recommended, and the waste pipe must be constructed absolutely water-tight. Above all, the use of cesspools, which lead the waste fluid away by filtering through the ground, should be absolutely

prohibited. They are entirely unhygienic, for they are likely to contaminate the water supply.

For little country places the practice proposed by the board of health in the state of Maine (United States) is to be recommended. Under the seat of the closet stands a water-tight bucket (Fig. 35), or one of cast iron, and in a box within the closet is a supply of earth, sawdust or ashes, of which the children are to throw a shovelful into the bucket after each use. One wagon load of this material is found to be sufficient for a school year. Daily, after the close of school, the contents of the bucket are removed through a door in the rear and are thrown on a compost heap or turned into fertilizer and covered with earth. When one sees the manure heaps of the countryside to which are added the waste deposits of the closets, it is not difficult to imagine that infection may spread by means of the domestic animals. This emphasizes the need for the school to exert its educating influence also in this direction as well as in another direction—that of ventilation. Many persons in the country never open their windows, with the result, as proved by statistics, that in rural districts preventable diseases are more frequent, comparatively speaking, than among urban populations. It is, of course, true that country children are more hardened than city children. Hence, it is permissible in country schools to have the closets out-of-doors, though it is desirable to construct a covered passageway leading out to the facilities.

Urinals.—It is not possible, with such simple arrangements, to keep urinals free from odors. For this reason, it is desirable not to install them, but to

have the children use only the above-mentioned closet. For special places the oil urinal* is an ideal arrangement. The walls are covered with a preparation to which urine does not cling and the oil in the siphon which collects the urine, covers it and renders it practically odorless. These oil urinals, which are being widely used, can be kept odorless with very little effort, which can hardly be the case when only water is used.

Bodily needs should be attended to during the recess periods; consequently the closets should be near the recreation rooms and the playground. Ordinarily one closet is planned for one class, but with classes of fifty or more additional facilities are needed. When the toilets are under supervision or the children have the impression that it is so, it is not necessary to limit particular ones to certain classes. Above all, the supervisors must see to it that the closets are not made untidy. Cleanliness can be best ensured if the children themselves are urged to report immediately any toilet found in an untidy condition. It is very convenient to have the lavatories connected with the toilets, but with regard to washing accommodation our schools leave much to be desired.

School and Dwelling.—The combined school and dwelling house needs brief discussion. It is a plan not to be rejected because it is often the only feasible one. In large cities, the ground is so expensive that a separate house for the principal and teachers is prohibitive. And again a school of this kind may be used for such a variety of educational purposes as to

*Made by W. Beetz in Vienna.

make the residence of the director within the building very desirable, and the work of cleaning and heating is also facilitated if the janitor is lodged in the house. In country schools where the children come from a great distance, it is of advantage to them to be able to get a warm meal cooked by some one connected with the school, who may also in other ways show her motherliness. Of course, care should be taken that such accommodation of the teacher and his family in the schoolhouse shall not prove a drawback to the school, which might be the case if patients with contagious diseases are kept within the schoolhouse, and odors from the kitchen or from impure water in the laundry, etc. are allowed to penetrate to the classrooms. In the interests of the director, his rooms should include at least one that is sunny and away from the noise of the children. The director is entitled to accommodations which will afford him and his family a commodious home; hence none of the rooms should be located in the basement nor should there be less than three living rooms.

The use of the schoolrooms for other than school purposes may prove hygienically undesirable; social gatherings may litter up the floor, and contagion from sickness may enter. It should be the duty of the city or town authorities to see that the health of the children is not endangered.

Cleaning.—The cleaning of the schoolhouse has already been mentioned and it must be admitted that in this direction much progress needs to be made. In this respect, as with regard to lighting, ventilation, seating, toilets, etc., the school differs by virtue of its

intensified use from other dwellings and demands special means to keep it sanitary. Improvement will come when the general public has been hygienically educated to realize special menaces to health, as well as conditions necessary to safety and comfort. Cleaning operations which will stir up dust should never fall upon the pupils. In this matter of cleaning, Denmark has made a distinct advance by introducing into the law of 1905 for the fight against tuberculosis a clause covering this point. Another exemplary provision is contained in an edict issued by the city of Copenhagen in 1908. It is practicable in large schools to contract for the cleaning and heating, as is done in some cities of Germany. Where possible, a vacuum cleaner should be installed.

Fire Regulations.—Large school fires and terrible panics among the children have taught the stern lesson that the construction of the school building and the order maintained during an emergency must be such as to avert like occurrences in the future. For this reason the fire drill at least once a month should be a matter of school routine. All large schools should be equipped with fire escapes, as is the case in American cities.

II

THE HYGIENE OF INSTRUCTION

1. General Consideration

Fatigue.—Prolonged labor of any kind leads to fatigue. Fatigue is regarded as due to the accumulalation in an organism of certain products of metabolism, the presence of which tends to diminish energy. It must not be supposed, however, that the subjective expression of fatigue, *i.e.*, the feeling of being tired, is an exact measure of the degree of fatigue, though it is usually an important indication. Following fatigue, rest, nourishment, and fresh air bring recovery from the tired state. But to aid the healthy development of the child more is needed than mere alternation of brain work and mental rest. The muscles of the child also require exercise for their growth; this exercise likewise produces fatigue and in its turn demands periods of rest. Fatigue is essentially a general condition; the products of dissolution which accumulate through brain work produce a diminished capacity of the muscles as well as the nerve cells, and *vice versa*. Weichardt in Erlangen (Germany) who has succeeded in injecting into an unwearied animal a substance called kenotoxin extracted by him from the muscles of a tired animal, has observed in the former all the characteristic signs of fatigue. To overcome this

experimentally produced fatigue, he then used an antibody, or reactive agent, which he injected into the animal. These facts are not cited as urging that a like procedure be undertaken with school children, though Lorenz in Berlin has proved that the spraying of an anti-kenotoxin in the air of the schoolroom diminished fatigue in the pupils. But such means of recuperation are not to be advocated, for fatigue signifies need of rest and if fatigue were artifically prevented new work would commence at the undue expense of the reserve power of the child. This is especially dangerous for children because they not only need to restore used material but to accumulate new material for growth.

These are problems which still await definite solution, though this much is certain—fatigue should never be permitted to reach the stage of exhaustion, that is, it should not be carried so far that the development of the child is hampered. The rule should be that complete recovery must follow a day's work before the next day's tasks are begun.

Increases in height and weight are good indications of proper development. If a child who has healthy parents and to all appearances a hygienic environment, still shows signs of physical backwardness, this lack of development must be regarded as an unfavorable sign. Constant watchfulness of the development and the hygienic conditions of school children is a matter of public interest. In this connection it might be particularly valuable if we could know how near at any given moment the state of fatigue is to its physiological limit, or whether it has already reached the pathological condition. Our

knowledge on this point is meager, which is not to be wondered at when we consider that research in this field has been undertaken only during the past few years.

A full discussion of the subject of fatigue would far exceed the limits of this book, but in order to give the reader an idea of the means taken to determine the presence of fatigue, a few methods will be presented. The psychological methods require the child to compute figures, to keep numbers or words in his memory, to recall previous happenings and to complete the sense of broken passages.

Another way is to estimate the fatigue elements resulting from either mental or physical labor by testing muscle capacity with the ergograph, an instrument designed by Mosso of Turin. The test made is of the amount of muscular work which can be performed by the middle finger, the subject lifting a weight rhythmically as many times as he is able. The weight hangs on a string which runs over a roller. The heights to which the weight is raised and the rapidity with which one stroke follows another are indicated by the instrument, and the sum of the results in the given time, with a given weight, constitutes the work, which is recorded in meter-kilograms. No matter what the cause of fatigue, the tired individual is able to perform only a fraction of the work that he is able to do in a rested condition.

Another plan, that of Weichardt, is to estimate the degree of fatigue by dumbbell work and foot movements; or, according to Schuyten of Antwerp, by a dynamometer which registers the pressure power of

the hands. The aim of the physiological methods is to show the decreased power of the sense organs under fatigue. If the finger tip of a normal individual is touched with the two points of a compass, he will be conscious of two separate sensations, even when the points are very close together; but in order to get two separate impressions when the compass is placed on the upper arm, the two points must be placed relatively far apart. It has been found by Griesbach of Mülhausen (Germany) that under fatigue the points of the compass on the finger tip must be widened to produce two sensations, and the degree of fatigue is indicated by the distance between the points. This is the æsthesiometric method.

While the results achieved by these methods indicate the general usefulness of such procedures, some very decided objections can be raised and the results of one method do not always corroborate those of another. But nevertheless we must not abandon the hope of arriving at a method which shall be free from objections. As a matter of fact, the researches made in different laboratories with different methods have already shown a general tendency in one direction.

Constitution.—That individuals differ in natural aptitude or constitutional tendencies as well as in development is a universal truth. The further fact, however, is not so well known that, as a rule, the children better equipped physically, that is the heavier and larger children, make better school progress on the average than the weaker ones, a finding which gives added meaning to the phrase, "a sound mind

in a sound body." This truth was wholly disregarded until Russian investigators emphasized its importance, and the extensive investigations of Porter in Boston, F. A. Schmidt and Lessenich of Bonn (Germany) corroborated the statement, which was further proved by the work of many other investigators, among them Graupner of Dresden, Quirsfeld of Prague, Rietz of Berlin and S. Rosenfeld of Vienna.

Defective Children.—The very great differences existing in mental capacity are better detected in the elementary, than in the high school, where a more or less selective process has operated. Because of a realization of this wide difference of aptitude among children much is heard about subnormal and backward children. From the standpoint of school hygiene such discussions are to be warmly welcomed. Among the subnormal the first to receive consideration in the school are the mentally defective, then cripples and epileptics, and moral defectives. The blind and the deaf have always received special care and need hardly be considered in connection with the public school. Finally we have children who are retarded because of chronic diseases such as tuberculosis and trachoma, as well as constitutionally weak children and those who are nearsighted in a high degree. Public interest is aiming to provide for all these the advantages of education, of which they would otherwise be deprived to a greater or less extent.

As a rule, mentally retarded children fall behind the normal in weight, as Schmid-Monnard in Halle (Germany) has shown. Malnutrition and sickness likewise play a large rôle among the backward. More-

over, because of their inability to keep pace with other, normal children, such pupils are at a disadvantage psychically. It frequently happens that the teacher for a time misjudges such children, regarding them as lacking in ambition. That there are intelligent children among the defectives who are unfit for the public schools is instanced by the word-blind.

Special Classes.—The normal, subnormal and abnormal are not separated by wide gulfs; there are gradual stages of transition from one to the other groups. The diagnosis of defectiveness is not always easy to make and hence special methods for testing intelligence have been designed. By placing the backward pupils in a special class final decision can be deferred for some time, though, unfortunately, parents frequently object to this procedure, notwithstanding that it is the wisest course for the child, who is thus taught by a specially trained teacher, in company with only a small number of companions, perhaps not more than twelve. In the special classes, the pupils can have a maximum amount of recreation, medical attention, etc., that is, they are especially cared for also from the standpoint of their physical health. The carefully kept records of these classes are frequently of value, as in examination for military service, or in questions of liability in a court of justice. Moreover, the practical training received in these special classes is of great advantage to those who at the end of school must earn their living. It has been computed that from 1 to 2 percent of the school children in different countries are defective—a number sufficiently large to demand special study and atten-

tion. In the city of Mannheim (Germany), Sickinger has made an attempt to systematize the care of the various types of subnormal children.

School Age.—Most children are ready for school when they have passed their sixth birthday, that is, they are then sufficiently developed to undertake school work. This age has been generally chosen because while up to the seventh year of life the brain grows rapidly, after this period, growth is at a much less rapid rate. That organ is therefore quite well developed when the child enters school, although not yet adapted for abstract thinking. The worst feature at the beginning of school life is this, that the transition from a state of freedom to confinement is too pronounced; the hours of instruction are too long and the recesses too short. It is demanded of the child whose interest is naturally fickle at this age, that he shall seriously concern himself with certain things, and he must, in addition, sit absolutely still. The fact that we are here concerned with a real problem is demonstrated by the investigations of Schmid-Monnard in Halle (Germany) who found that among children of all ages, from birth to the fourteenth year, those showing the least increase in body weight belonged to the seven-year group, *i.e.*, those in the first year of school life, while those children who for some reason spent this year out of school showed a decidedly greater increase in height, as well as weight. In the case of weak children, the effect was evident even in the second school year. Hertel of Copenhagen, basing his conclusions on observation made upon

thousands of children, found that there is an increase of illness at school entrance.

Co-education.—One of the most important educational problems of the present day is the co-education of boys and girls. The subject can be considered here only from the point of view of school hygiene. The question reaches its most critical stage with regard to the secondary school, for in the elementary school the requirements are less severe and moreover there is separation of the sexes so far as gymnasium work is concerned, because of the weaker frame and musculature of girls. But, as we shall see later, even in the elementary school the subject of boys and girls in one and the same school deserves further consideration.

The origin of co-education in Europe lies in the tendency to increase the earning capacity of woman. Co-education is the consequence of the attempt to equalize the position of the sexes. In addition, certain practical questions are often involved, for instance, a community may not be able to afford a separate high school or college for girls, and again the number of girls desiring this education may be so very small that accommodation might easily be arranged at a boys' school. In view of the more taxing curriculum demanded in the secondary as compared with the elementary school, the highly diverse physiological differences of the sexes demand paramount consideration. As the subject is large, only a few facts of experience and those gathered from statistics will be given. Of the greatest importance is the difference of development at puberty. The

period of pubescence in boys is longer than in girls; but it more deeply affects the girl, as it is connected with greater changes in the body, and a successful transition is of the greatest significance to the woman of the future. The first appearance of menstruation, in the temperate zones between the ages of fourteen and sixteen years, is only the final manifestation of a whole chain of developmental processes. The determining factor in this consideration must be the comparative vitality of the two sexes, as it can be learned from the study of a rich array of statistical evidence concerning sickness and mortality. A few such facts are shown below.

TABLE I. A COMPARISON OF BOYS AND GIRLS IN SECONDARY SCHOOLS WITH RESPECT TO ILLNESS*

Name of investigator	Country (or city)	Boys		Girls	
		Number examined	Percent sick	Number examined	Percent sick
Hertel.....	Copenhagen	1,900	31.1	664	39.4
Danish Commission	Denmark	16,789	29.0	11,336	41.0
Key.....	Sweden	11,210	34.4	3,072	61.7
Norwegian Commission	Norway	830	21.9	500	36.7

*The boys in these cases are from public Latin and modern schools, the girls from similar private schools, with the exception of those examined by the Danish Commission, where both boys and girls were students of the public schools. The Latin and modern schools are mostly day schools supported by the state, the parents paying a moderate tax, or in case of poverty, nothing. (In reading the book it should be borne in mind that the educational systems of Germany and Scandinavia differ from the American. The "higher schools" of Europe do not correspond to our high schools: they do not follow the elementary schools, but rather overlap some of the work of the lower schools. Translators.)

The above statistics have been selected because they include large numbers and the pupils are distributed over a wide geographical field.

Certain pathological manifestations, as anæmia, chlorosis, and recurring headaches, are particularly frequent among girls, who also are more prone to develop irregularities of the spine, all of which would seem to point to a lower capacity for resistance. These statements are substantiated by the findings of the pathological anatomist Key of Stockholm, whose investigation has already been mentioned in the preceding table.

TABLE II. KEY'S FINDINGS OF CHLOROSIS AND HEADACHE

	No. examined	Chlorosis	Habitual headache
Boys.....	11,210	12.7%	13.5%
Girls.....	3,219	35.5%	36.1%

With reference to anemia in girls, Tjaden in Giessen found the following:

TABLE III. TJADEN'S FINDINGS OF ANEMIA

	Autumn examination	Spring examination
Boys	5 = 0.7%	18 = 2.1%
Girls	121 = 13.6%	157 = 16.0%

Eulenberg in Berlin found among 300 children afflicted with spinal curvature that 13 percent were boys and 87 percent girls.

The findings of Lindholm in Helsingfors (Finland) the school physician of a higher co-educational school, are:

TABLE IV. LINDHOLM'S FINDINGS OF ANEMIA AND HEADACHE

	Anemia and general weakness	Habitual headache
Boys	22%	10%
Girls	38%	31%

A number of observers point to the thirteenth year as the most critical for girls, that is, during this year there is more illness than in others. If we consider the usually accepted standard of education, that for the boy, this year as a rule comes when the girl is already in the higher school. In Helsingfors where physical training is compulsory and excuses are granted only on the statement of a physician, Palmberg has found that in the elementary schools among 1,684 boys and girls none were excused, while in the higher schools he found the following:

TABLE V. EXCUSES FROM PHYSICAL TRAINING GRANTED TO PUPILS OF HIGHER SCHOOLS IN HELSINGFORS

	Higher public schools		Higher private schools	
	Total	Percent excused	Total	Percent excused
Boys	1,152	1.30	1,275	3.06
Girls	1,306	3.70	973	11.63

The reason for excuse of 51 percent of the boys and 35 percent of the girls was functional disturbance of various kinds, while 49 percent of the boys and 65 percent of the girls were excused because of general debility. Lindholm's results in eight small towns in Finland show similar ratios.

This array of statistical data would seem to show that from the viewpoint of hygiene the co-educative

system in high schools is detrimental to the health of girls. The argument of lesser mental ability in the case of girls has been proved wholly futile: indeed, the results show that girls succeed rather better in their studies than boys. Hygienically important is the fact of the greater suggestibility in the case of the girl, as is proved by the spread of psychic epidemics, for instance, muscular twitching in girls' schools rather than in boys'. For this reason also, one might almost say unfortunately, girls are more readily stimulated to increased endeavor, which in view of the great demands made in the high school and the unquestionably smaller resistance force of the girl, can not be considered as advantageous to health.

It is difficult, in view of the above mentioned and absolutely unbiased facts, to meet the demand of the present time for the higher education of girls, a demand which is based not alone upon ideal considerations, but also upon necessity. There are other grounds as well on which co-education has been condemned, one being the moral question, though we do not consider these arguments conclusive. If there are separate wardrobes and toilets, and if the gymnastic exercises are not given in common, there is little to be feared from competition in the schoolroom and the meeting of boys and girls in supervised playgrounds, even though occasional irregularities, often springing from natural impulses, have been reported. When it comes to that, objectionable practices are also found in separate schools and it is doubtful whether co-education increases them. Especially in small towns where the young people meet outside of school it is true that

public opinion acts as a control; this, of course, is absent in large cities.

The real hygienic difficulty of co-education is presented by the curriculum. In accordance with the incidence of sickness found among girls, the curriculum beginning with the tenth year of life should be better arranged to meet the requirements of health. Guided by the investigations of Key, we must consider the period of pubescence as one of lessened resistance, and the years of development into womanhood as requiring the greatest care, for it may otherwise happen that during this critical period pathological conditions will develop which are carried throughout life. For this reason, the curriculum of the higher school must be differently planned, there must be less sitting still and more exercises in the open air. One solution would be to have a lower standard of work for girls at a certain age in those studies which are most taxing, and to plan the curriculum with special reference to the endurance of each year. The free hours should be used for bodily exercise. This means, of course, that in a co-educative system the girls can not compete in the same examinations with the boys. That, however, should not prove an insurmountable difficulty, for those girls who are not seeking the education as a step to self-support would no doubt be satisfied with a restricted curriculum, while to the remainder, opportunity might later be afforded, when they have attained maturity, to complete their studies, so as to enable them to take the full examinations. If girls would be content to add an additional year or a year and a half to their school course, there would be no disproportion

in the end in countries where young men are obliged to spend some years in military service.

In Europe co-education in the high school has been developed to its fullest extent only in Scandinavia and Finland, where it is being attacked by present-day hygienists. It is spreading in Switzerland and in the German Empire (Baden, Württemberg, Saxony) and is beginning also in Austria. Conditions in the United States can not be compared as a whole with those of continental Europe because such varied practices exist in different states. Co-educational colleges have been established, especially in the west and south of the United States. They differ from the European plan in that students may choose their subjects in part, and the healthful recreation afforded by the school is open to both sexes. It is a noteworthy fact that at the passage of the new rules for girls' high schools the school board of Prussia has taken account of the lessened resistance of girls and has taken action accordingly. In view of the profound significance that the higher education of girls has for the individual, the family, and the state, a definite regulation by a provision such as the Saxony law of 1910 is heartily to be recommended. At all events, care should be taken in every co-educative high school to prepare a different curriculum for girls than for boys. This conclusion seems unavoidable in the light of the facts that have been presented.

2. Number of Pupils and Curriculum

Number of Pupils.—The meeting together of many individuals in one room for instruction is the most

characteristic feature of the school. We have already discussed how the usefulness of this room is affected by the fact that the daylight diminishes in proportion to the width of the room, and how the size of the classroom is controlled by the limits of hearing and seeing. These limitations affect also the number of children who can constitute a class. It has also been mentioned that the air of a classroom becomes rapidly unhygienic, even when 4 cubic meters of air are allowed for each pupil. At this rate, a room measuring 9 by 6 by 4 meters can accommodate about fifty pupils, though the total number of cubic feet (216) can not be considered as being wholly air space, for the furniture and the children themselves take up room. The number fifty has been determined on the grounds of light, air, etc. But experience teaches furthermore that contagious diseases and moral delinquencies make headway easier in large classes than in small; and the teacher of a large class finds it difficult to accustom many of the children to correct posture. That the instruction itself must suffer is absolutely clear. This fact is of hygienic importance in so far as it concerns certain unfavorable psychic effects upon some children, who need individual attention which they cannot receive in an overcrowded class. Lastly, an overcrowded class does not afford healthful work for the instructor.

The problem of the number of pupils to a class is not to be solved purely from a hygienic standpoint; often it must be a question of finances. That it can be successfully solved, however, is proved by a number of instances. According to the law of Norway passed in

1889, the maximum number of children in country classes is 35; under pressing economic conditions it may be 45; in cities the numbers are 45 and 50 respectively. According to the published reports of average classroom attendance, we find that for instance during April 1900, the average number of school children per class in Christiania was 33.1; in Drontheim at the end of September, 1901, 31; in Bergen, 33.9; in Stockholm, in 1893, 36—all well within the lawful maximum. In Denmark, the law of 1899 limits cities to classes numbering 35 and country schools to 37, and it must be mentioned that additional funds were also appropriated to meet the need created by this law. In London the number of children under one instructor decreased during the period from 1873 to 1903 from 80.5 to 41.9 pupils. All the above-stated numbers apply to public schools. In Alsace-Lorraine the law of 1883 stipulates that for the three lowest grades of the higher schools the number shall not be more than 40; for all others the maximum is 30. The edict of Prussia, issued in 1894, specifies 40 as the largest number allowed per class in secondary schools for girls. Where such limits have not been set, it would be of material help if at least for the more difficult courses the overcrowded classes of high schools were divided into two sections.

In speaking of classes of fifty it was not intended to indicate this number as a hygienic ideal. It is mentioned as being hygienic only by contrast with the overcrowded condition of public and high schools everywhere, and because it promises to be a *possible* ideal. Overcrowding is an evil which has crept into

the schools because formerly no hygienic limits were thought necessary, and so deep-rooted has it become that to make too radical demands at once, as for instance those of the Danish law, would defeat the ends in view and mean no progress. The subject of the number of children to a class has been discussed in detail because of its pedagogical and hygienic significance. If in this direction a public spirited community should feel impelled to make sacrifices not demanded by law, it may rest assured that funds so invested will bear satisfying interest in the increased health of its children.

School Hours.—The morning is the best time for school work, but one of the most important requirements for the development of the child is sufficient sleep. The sad story of children shortening their hours of sleep because they must engage in industrial pursuits will not be gone into here; it is mentioned only to emphasize the fact that enough sleep is the absolute right of every child—and the recognition of the rights of the weak marks the culture of any civilization. But in addition to individual work, there may be other conditions in the home which will prevent early retirement; the child may live a long way from the school, and the home work required may be so heavy as to shorten the hours of sleep. Bicycling to school, or daily travel by train may be bad for the child if the way is too long and the trains are run at inconvenient hours. At any rate, conditions are not right when the child must be awakened from sleep. Every child should be trained to wash and dress himself properly, and to breakfast without haste. To begin the day

in a state of hurry is harmful to health. In the case of little children, a long walk to school which in the winter must be begun when it is still dark, and morning classes with artificial light, are often detrimental to health. On the other hand, early school hours may prove an advantage to children, for instance when the parents work in factories; the child may thus enjoy the comfort of a warm room in the schoolhouse instead of spending an uncomfortable hour at home. And, again, conditions in rural communities are different from those in the city— in the country people retire early and arise early. Hence it is not possible to lay down any hard and fast rule as to the most hygienic hours for opening school, although with regard to the city it is generally admitted that nine o'clock is the most desirable time, at any rate in winter.

Carrying of Books.—The best way to carry books, both for boys and girls, is in a knapsack attached to the shoulders by broad straps. The daily carrying of books on one side of the body, either by a strap or in the hand or arm, results in many cases of lateral curvature of the spine, especially among girls. Fig. 36 illustrates the different positions which the body assumes with different methods of carrying books. It is becoming increasingly customary, even in girls' schools, to require the children to carry knapsacks, but the enforcement of their use is not all that is necessary; the bag must not be too heavy, or the consequences may be a bent back or collarbone. The weights which children are obliged to carry are sometimes very considerable in proportion to their

body weight, the books aggregating one-fifth of the whole weight of the child, as has been shown by the investigations of Eulenberg in Berlin. Hence this matter has long received the attention of school boards. It is, of course, a fact that many children,

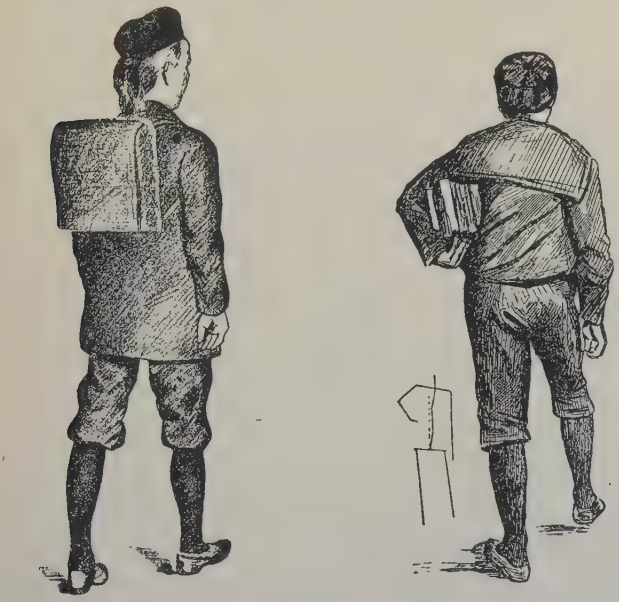

FIG. 36.—Two ways of carrying books. Note the diagrammatic outline.

and especially the younger ones, like to carry books which they do not need, and parents and teachers should be urged to make an occasional inspection of the school bag to see that it contains only what is necessary; but again it will often be found that children are re-

quired to carry great piles of books. In the London schools it has long been the general custom to leave books not needed at home in the school; in some cases rooms provided with shelves are set aside for this purpose. Prussia, also, has made this provision in girls' schools. In Austria the law provides that school books must be light in weight; that is, where formerly a book was published for use during several years, it is now published separately for each year.

Inspection for Personal Cleanliness.—It is greatly to be recommended that at the beginning of school, the teacher inspect the children from the standpoint of cleanliness, reprimanding those who come uncombed or with dirty fingernails. Unfortunately, merely sending a note to the parents of neglected children does not help materially; but much can be done if the school is equipped with practical washing arrangements, as in London, and the children are educated in cleanliness. In Vienna, Tlŭchŏr has advocated marking for cleanliness, which is to be warmly recommended trying first of all. In some countries it is customary for the children to kiss the hand of the instructor at the beginning of school, but this is a mark of courtesy which should be discouraged by teachers, as contagious diseases may be spread in this way.

Length of Instruction Periods.—In watching any lecture audience, it is observed that after about three-quarters of an hour many persons will begin to shift in their seats; they will yawn, and in other ways demonstrate that the period of attention is too long, though their attendance is voluntary and no other

lecture may have preceded, nor is one to follow. For the best pedagogical results we require of the child that he shall give undivided attention, and according to the new methods of teaching we endeavor to hold this attention by questions directed now to this child and now to that. But it is probable that the great mass of the pupils is unable to follow the instruction intensively, though there are varying degrees of inattention, according to the age of the children, the number of years they have attended school, according to the topic under discussion, the personality of the teacher and the number and character of the preceding lessons, etc. While as a rule the inattention of the pupil will act as a safety valve, as Kraepelin has said, protecting the child from being overtaxed, it is surely regrettable that the majority of the pupils in a classroom is compelled to receive instruction for longer than the profitable, receptive period. We are as yet ignorant as to the exact number of minutes during which most children are physiologically able to give strict attention under conditions which vary from hour to hour, and day to day, although a beginning in this direction has been made. But even if we possessed this information, a strict adherence to any such ideal would be impracticable in the school. The above illustration of the lecture audience does, however, seem to indicate that we can not demand of the child a full hour of undivided attention, much less a second hour. Endurance tests that have been made with figuring and writing from dictation seem to corroborate this assumption.

But there are still other considerations which con-

demn the long lesson. The air of the room undergoes unfavorable changes, a fact which becomes doubly significant when the children are bending over and are engaged in mental work; the result is a shallower, less forceful breathing. These facts, and the additional hygienic necessity of shortening the period of sitting still because of the need of exercise and relaxation from eye strain seem to make it clear that a classroom lesson should not exceed forty-five minutes in duration and should always be followed by a recess. In the case of beginners, even this period should be interrupted by a three-minute pause during which the children can relax and chat. Some brief gymnastic exercises as originated in 1904 in New York are to be recommended for the recess period, though the end would be defeated if the pause were devoted solely to this purpose. Mohaupt, the experienced school director of Leipa (Austria) has for a long time allowed these "talk" pauses, in the interests of hygiene. For beginners, half-hour instead of hour lessons have been instituted in the Berlin public schools since 1898. In the province of Hessen (Germany) the forty-five minute lesson was regulated by a decree in 1883, although it had already been generally adopted previously. Prussia has made three-quarter-hour classes in the high schools obligatory since 1911; such periods had been the custom since 1909. Keller in Winterthur (Switzerland) has even carried out forty-minute lessons.

Recesses.—As has already been stated, recesses are an absolute hygienic necessity. The rapid deterioration of the air of the classroom makes a thorough

airing imperative, the eyes should have opportunity to glance at objects at a longer range (nearsightedness, p. 157), and there should be an opportunity for breathing more deeply. The circulation, also, is stimulated by the change from a sitting position, and there is a release of abdominal pressure. The children must also have time to attend to their bodily needs. Too long sitting on a warm seat may likewise stimulate the sex organs.

From the preceding it is clear that not only must there be recesses, but such intervals must be used to advantage. Above all, the pupils must leave the classroom in a body, so that the room may be aired thoroughly. This, again, brings up the matter of recreation rooms and playgrounds and emphasizes their necessity. When returning to the classroom, after having been in the open, the children bring in fresh air with them. It is also clear that the children need some exercise during the recess period, but it entirely defeats the object of the recess merely to marshall the children up and down. With reference to recesses, the words of the Japanese Minister of Education, embodied in the decree of 1894, are pertinent: "The joyous abandonment of children to their sports, screaming and racing, is not to be counted as bad behavior, nor are those who sit about entitled to special credit on that account." Many American and European teachers consider loud noises during recess an indication of bad discipline and yet hundreds of children at play, if they are to play joyously, can not of necessity be mute. It is, of course, not wise to devote the entire recess (twenty

minutes) to very strenuous play, because although this might be beneficial to physical health, such exertion tends to diminish the mental energy required for the ensuing period (p. 120). The same can be said of gymnastic drills, which demand strict attention and strenuous muscular work, for we are not yet in a position to demand that active play and exercise shall be followed by a period of absolute rest. A recess offers a good opportunity to take a bit of food or a drink of pasteurized milk, served warm or cold, according to the season. However, the eating of sweets or eating just before the noon-day meal should not be tolerated.

In regard to the length of the pause between two lessons, it is evident that one of five minutes' duration will not be sufficient for large schools, for in that time it will not be possible even to take the children to the recess place, much less give them time to satisfy the appetite which they naturally feel if the breakfast has been light. In addition, time must be allowed for other necessities. It seems necessary, therefore, that a forty-five minute lesson should be followed by a recess of at least fifteen minutes. Naturally, part of the fifteen minutes will be taken up in passing to the yard and back again. The recess should never be forefeited on account of bad behavior.

The objection might be raised that the recess period means a pedagogical loss, corresponding to the length of time devoted to recreation. On this point we desire to cite an investigation which serves at the same time to illustrate the test methods mentioned on page 77.

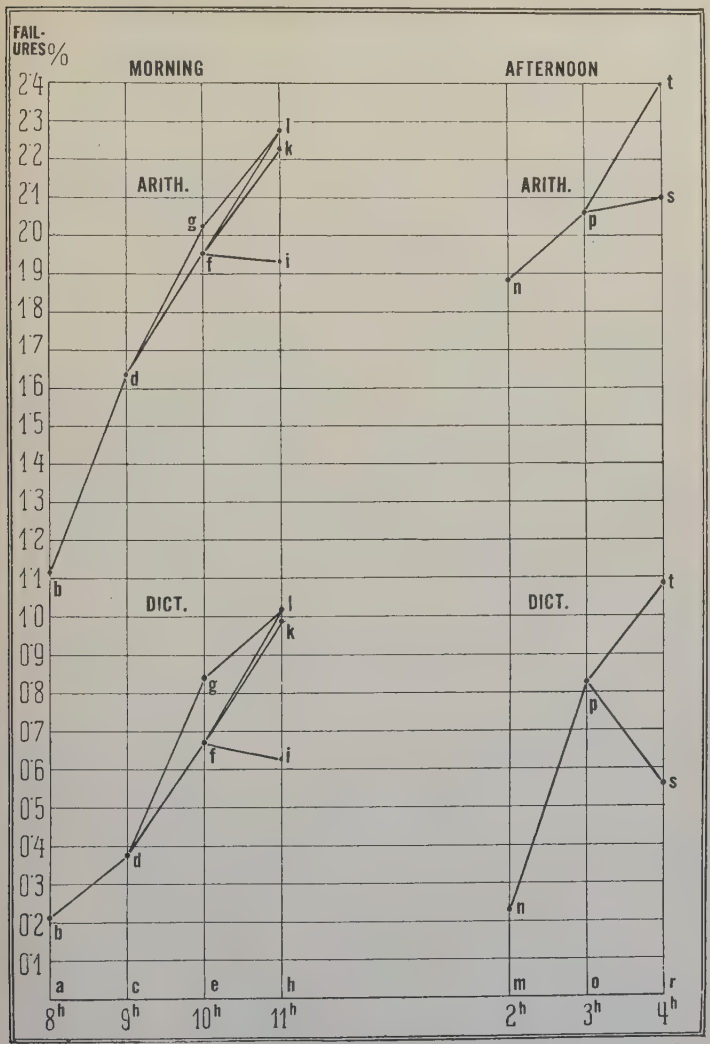

FIG. 37.—The effect of recess periods on work in arithmetic and dictation, according to Friedrich.

In an investigation conducted by Friedrich as to the working ability of ten-year-old boys in the public schools with or without recesses, the following conclusions, which are graphically shown in Fig. 37, were obtained. The tests consisted of dictation and arithmetic. The children were examined before school, after the first hour, and again after the second and third; also in the afternoon session, before and after the first hour, and after the second. Fig. 37 shows on the lower line the time when the tests were made, on the left-hand side, the average percentages of failures in dictation (Dict.) and arithmetic (Arith.). The results shown in the figure were produced under the following conditions:

Morning Session

a – b = tests made before the first hour
c – d = tests made after the first hour
e – f = tests made after 2 hours, with a recess of 8 minutes between
e – g = tests made after 2 hours without recess
h – i = tests made after 3 hours with a recess of fifteen minutes each after the 1st and 2nd hours
h – k = tests made after 3 hours with only one recess of fifteen minutes after the 2nd hour
h – l = tests made after 3 hours with no recess.

Afternoon Session

m – n = tests made before the first hour
o – p = tests made after first hour
r – s = tests made after 2 hours with recesses of fifteen minutes after the first and second hours
r – t = tests made after 2 hours with no recess.

The effect of the recess is shown in the differences which the lines f–g, i–k, k–l, i–l, and s–t ex-

press respectively for the morning and afternoon. The recess periods were taken from the lesson time. The significance of the investigation is this, it brings out clearly that the time lost in lessons and devoted to recreation is compensated for by the increased mental productivity of the children.

Order of Subjects.—In regard to the order of subjects in the curriculum, it is to be recommended that those subjects demanding reflection and memory, if possible should come early in the morning session, and such as require the best day-light, like writing, drawing and fine handwork should be reserved for the brightest part of the day, as has been prescribed in Austria since 1878. Two periods in which the pupils use their eyes at near range should not follow each other. It must be admitted that the departmental system of high school offers difficulties often insurmountable, in carrying out a plan of this kind.

It would be of value if we knew exactly the fatigue point of the various subjects in the curriculum. For example, we know that it is less fatiguing to pupils in the high school to devote an hour to describing a number of growing plants, of which they have specimens, than to spend the same length of time on a geography lesson, tracing out intricate mountain systems on a map, although in both cases the subject is nature study. Likewise, it makes a great difference in a foreign language class whether the task is translation of an already familiar author, or a lesson in syntax, and in mathematics, whether the time be devoted to grasping the principle of the new abbreviated method of multiplication or mechanical

practice when it is fully understood. In addition, we must take account of the great diversity of personality in the individual teacher, so far as pedagogical equipment, patience, strength, etc., are concerned. Because of deficiency in these qualities it may happen that the "easiest" subject may become the most difficult for the children. Thus it will be seen that it is not easy to determine the fatigue capacity of any particular subject. Before we can arrive at the scientific arrangement of subjects according to their difficulty for the pupil much intensive research work on fatigue must needs be done. Physical exercise also plays an interesting part as we shall see later.

The One or Two-session Day.—A much discussed question is the one or the two-session day. It is not possible in the case of all schools to complete the curriculum during the morning, especially if the opening hour be late. A division of the work between the morning and afternoon, with a long intermission between is not objectionable on theoretical grounds if conditions for both sessions are equally favorable, as in boarding school, but in the majority of day schools this is not the case. The chief difficulty is offered by the noon-day meal, not to mention the other disadvantages of unfavorable light on winter afternoons, oppressive heat in the summer, as well as the fact that many children feel certain depressing psychic influences during the noon period, such as may be caused by impending examinations. In many countries, especially in Europe, it is customary to have the chief meal of the day at noon—a hygienically disadvantageous arrangement, which was

discussed by the author twenty-five years ago,* and in regard to which public opinion is slowly changing. The principal meal of the day is followed by great physiological exertion, *i.e.*, the work of digestion, during which a greatly increased volume of blood is distributed among the digestive organs. The adult very plainly feels a need for physical and mental rest, and if he forces himself immediately after into energetic work his digestion is likely to suffer. The digestive process is even more important for the child because digestion in his case is not merely a matter of metabolism, a building up to replace what has been torn down, but also of growth. The tremendous physiological effect is readily realized by the teacher of the afternoon classes, who on his part is also conscious of a feeling of lassitude. Hence the afternoon instruction will be very fatiguing and the result below what otherwise it might be. (Compare tests made during morning and afternoon session, as shown by Fig. 37, p. 99). In addition, we frequently have unfavorable psychic states, as already mentioned; and the conscientious pupil will shorten his dinner hour to prepare for the afternoon, or the way back to school may be so long that the period of rest can be but brief.

The work of Schmid-Monnard (Fig. 38), must be mentioned in this connection. An investigation was made by him for the purpose of determining the percentages of illness of pupils in Halle (Germany) in the case of those who attended afternoon sessions and those who went to school only during the morning

*This discussion also appeared sixteen years ago in the first edition of my "Handbuch der Schulhygiene."

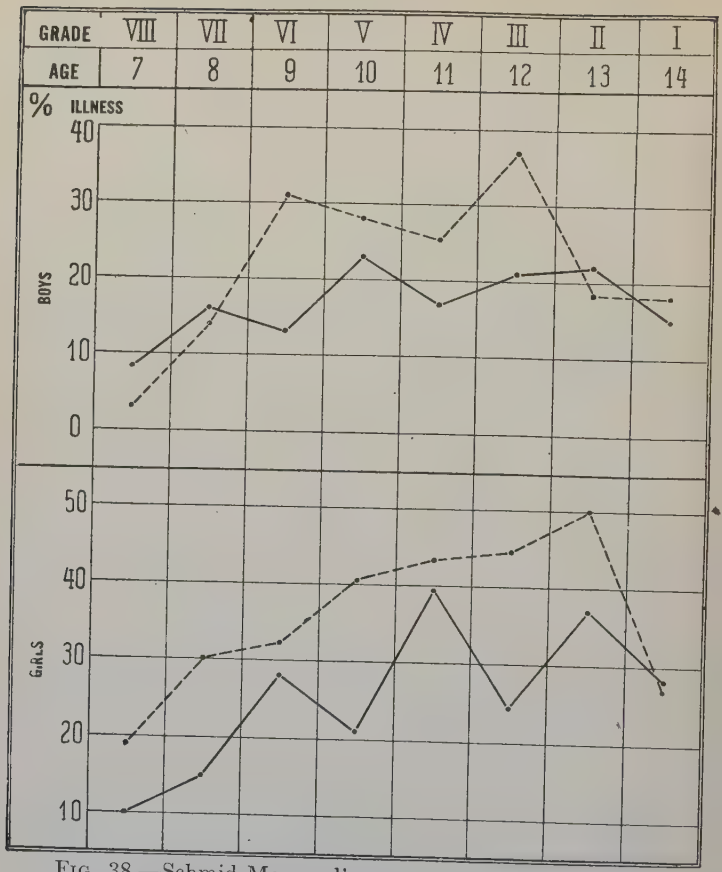

FIG. 38.—Schmid-Monnard's curves of illness among pupils in Halle, Germany. The dotted line shows the percentages of illness among those who attended both morning and afternoon sessions. The continuous line shows the percentages of those who attended only the morning session.

hours. His material included 2100 boys who attended both sessions, 540 who had only the morning work;

1900 girls of both sessions, and 480 who went to school only in the morning. The result, as expressed by the curves of Fig. 38, needs no comment. Steinhaus found similar conditions in Dortmund (Germany).

The case stands differently where a more sensible division of the day obtains—a hearty and later breakfast, later beginning of school, a very light meal in the middle of the day, which might even be eaten in school during the intermission, and the main meal at the end of the working day in common with all the family. The one-session school day is in use in a number of German cities, in Hessen, and in Denmark, while in Austria there is a tendency in that direction, especially in the higher schools. Another great disadvantage of the two-session day is this, that the pupil's time is so distributed, especially in the city, as to leave but small opportunity for physical exercise, walking, skating, swimming, etc. For that reason, the single session was introduced in the gymnasium (Latin school) of Giessen (Germany) as early as 1883, where five short periods, with recesses between, make a session of four and a half hours. Five periods with comfortable pauses between are entirely feasible for secondary schools. The decree of Prussia, passed in 1911, permits even six consecutive forty-five-minute periods—a provision which seems practicable in that it leaves the afternoon free, though it may not be desirable from other standpoints. Considering all things, it is clear that the lengthened morning session of consecutive, short lesson periods, broken by recesses, is the lesser evil in comparison with the long two-session school day. The curric-

ulum as it exists in many high schools demands of the pupils too many hours of desk work, both in the school and at home.

3. The Hygiene of Different School Subjects.

Reading.—Reading may be harmful if the lighting is bad, if the seating is faulty and if the print is poor. Large print, such as is usually found in primers, is necessary for the beginner, but the upper limit, that is, letters measuring 14 millimeters, should not be exceeded, because the eye in fixing on a certain point at a distance as is usual in reading, can not readily distinguish beyond a radius of 7 millimeters. The transition from the larger primer print to the smaller normal print should be gradual. For beginners the use of a "reading machine" is of great benefit; very large letters, which are not limited to the above-mentioned size, are placed on the teacher's desk or on the blackboard, and the children sitting comfortably in their seats learn with ease. Graupner has set 66 millimeters as the fitting height for these letters. During this exercise, the children should not sit so that the light from the window strikes into their eyes.

For the school books themselves Herman Cohn has laid down the following hygienic rules:

The main strokes of the type in the body of the book should be at least 0.25 millimeters in thickness and the breadth of the letters such that not more than seven of these come to a centimeter. The lines should be no more than 10 centimeters

in length and the letter "n" about 1.5 millimeters high with the distance between the short letters in two consecutive lines at least 2.5 millimeters. This may readily be seen in the present specimen from the distance between the letters "s" at the end of the first and second lines on this page. This specimen, furthermore, illustrates all the above mentioned requirements. (The length of the lines here illustrated is only 8.4 centimeters.)

Schubert in Nuremberg (Germany) who has made a special study of school books has orginated the conception of *Druckdichtigkeit* (thickness of print) as a criterion. Cohn then invented the "line counter and alphabet measure"* which can readily be made at home by cutting a square centimeter opening in a visiting card, measuring off on two neighboring sides of the square a scale of millimeters and half millimeters and also striking a line 0.3 millimeter thick to the brim of the card. When the little apparatus is laid on a page not more than two printed lines should appear in the hole, and the thickness of the letter strokes should not be greater than the 0.3 millimeter test mark. The print should be in deep black ink, sharply defined; the paper not glossy, and no print must show through on the other side. In reading, the distance of the eyes from the book should be as great as the height of the child permits. Children are apt to lessen the distance to a point which is injurious to the eyes, not only because an erect posture

*This "Zeilenzähler und Buchstabenmesser" can be procured from F. Tiessen of Breslau, Germany.

demands more work of the muscles than a stooped position, but because the image thrown by the object on the retina appears larger with a shorter range. The result is bad posture.

It is, of course, true that the above-mentioned requirements of Cohn are frequently disregarded, but that they can be met has been proved in the schools of

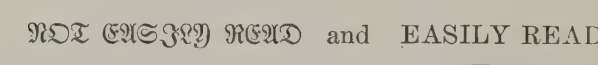

Fig. 39.

Basel (Switzerland) since 1886. In the maps used by the children in their atlases as well as the wall maps, only the relevant matter should be included, making it possible to use larger print and preventing unnecessary eye strain attendant upon searching for the required point among a number of others. Care must also be taken at home to see that the children do not

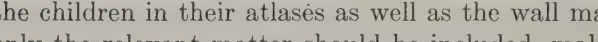

Fig. 40.

read badly printed books, in a poor light, in a bad posture, or for too long a time.

The children of Austria, Germany, and Switzerland are obliged to become familiar with eight varieties of type, that is, Old English and Roman letters, capital and small letters, and printing and writing alphabets. Lately a tendency is becoming manifest to turn the

attention only to the Roman alphabet. The greater ease with which the latter can be read is illustrated by Fig. 39, which compares "not easily read" in Old English with "easily read" in Roman type. Compare also the intricate curves of the Old English "B" (Fig. 39) with the simple lines of the same letter in Roman type, also the small letters of the German script, Fig. 40. It would be a great gain in hygiene if the substitution of Latin for Old English type could be made in German books. Of course, the great difficulty is that the Old English type is regarded as essentially characteristic of the German language although so eminent an authority as Jacob Grimm has shown the error of this assumption.*

Writing.—Writing is a matter even more serious than reading. For children who begin to learn at home, the slate is to be condemned altogether, and pencil and paper, and eventually pen and ink should be substituted instead. The slate easily becomes scratched and gray, the writing on it is gray and difficult to decipher, while the fingers of the child often assume a cramped position because of the hardness of the writing material. The slate pencil is also quickly blunted. In school, where the teacher can not give undivided attention to each child, the disadvantages increase, for the children will spit on the sponge or the rag with which they wipe the slate, and worse yet, lend these articles to their neighbors. At any rate, the slate should not be used beyond the first year of school. It has been abolished entirely in some cities, for instance, in Berne (Switzerland) and

*See his Deutsches Wörterbuch, Vol. I, p. lii.

in Klagenfurt (Austria). On the European continent trials have been made at various times to invent a white equivalent for the slate but so far no success has attended these efforts.

The surface of the writing paper should not be rough, shiny or transparent; the height of the notebook must not be over 20 centimeters, and the length of the lines not over 11 centimeters; the higher and wider the book, the easier it will be for the children to fall into bad positions. Badalini of Rome in his exhaustive researches extending over many years has demonstrated the fact that respiration is diminished in consequence of bad position. The small letters of the writing should not be less than 3 millimeters high; letters over 5 millimeters are too large in proportion to the finger length of small children. The children should also be watched at home, so that they will not get into the habit of writing too small.

Schubert who has made the greatest contribution to the hygiene of this subject has drawn up certain rules, substantially the following. In writing, the notebook must lie directly in front of the body; hence notebooks which are too wide must either be used in sections or moved gradually to the side as the writing proceeds. In writing from a copy, the latter should not be held to the side, but in front of the writer.

An imagined line passing through the center of the eyes of the pupil and also the line of the shoulders should be horizontal with the desk edge, which means the upper part of the body must not be bent forward or sideways. The chest must not be pressed against the edge of the desk, but kept a few centimeters away

from it. The head may be slightly bent, and the distance of the eyes from the work will then correspond to the height of the child. The child should sit fully on the seat, the legs not crossed, with the feet placed firmly on the floor. The elbows should be a hand's breadth from the body, two-thirds of the forearm resting on the desk, with the hand only slightly bent toward the left. The little finger and the wrist may touch the surface of the page. The penholder must be held at a distance from the pen point, with the upper end not pointing toward the shoulder, but toward the elbow.

The first lessons in writing should be devoted mainly to acquiring the correct posture. It is better to begin with the actual writing only during the second half of the first school year, as suggested in the plan of instruction in Zürich (Switzerland). The writing period if it lasts an hour should be interrupted frequently by a change of position, especially if the children show fatigue. During those pauses, the children can receive oral instruction or they may perform such easy exercises as bending the neck backward against the collar, stretching the body, etc. In order to cultivate good writing habits it is necessary to have comfortable desks both in the school and at home.

Vertical or Oblique Writing.—Many investigations have been made into the superiority or the inferiority of the vertical stroke over the slant in writing and *vice versa*. Schubert especially has devoted himself to the problem. It is possible to discuss here only a few of the controversial points. There are two possible positions of the copybook with respect to the

pupil. It may lie either in front of the body or to the side, but as the latter position is generally considered impracticable, we need concern ourselves only with the front position. The book may lie on the desk straight, so that the lower edge is parallel with the edge of the desk, or it may lie obliquely, with the lower edge ascending to the right. The down stroke of the pen must in any case be toward the body. There are two concepts in this connection: first, the base line, that is, the line which joins the middle points of the two eyes; and the plane formed by that base line and the point of fixation, which constitutes the range of vision. Imagine a ruled copybook lying straight on the desk, immediately in front of the child, who attempts to make down strokes. Under these conditions, the writing will be vertical. But if the copybook page is laid in front of the pupil oblique to the edge of the desk, the down strokes will be oblique, and we have the slanting writing. It will be seen that the essential difference between the two types of penmanship lies in this, that in the one case the ruled line is parallel with the edge of the desk; in the other case it is oblique to the edge. The movement of the hand in making the down stroke remains the same in either case, though this is not true of further strokes as the writing proceeds.

Experiments and investigations of many sorts have been made with reference to the movements of the eyes and head in relation to the down stroke as well as the other strokes, the distance of the eyes, the position of the hand and arm. It has been found in comparing the two types of penmanship with refer-

ence to the position of the head, the direction of the shoulders, the distance of the eyes from the page, that the vertical writing gives more favorable hygienic results. The children writing the slant held the forearm at a great distance from the body, while the arm of those writing vertically was almost close to the body. The advantage of the latter position lies in this, that it is not necessary to bend the body as deeply as when the arm is spread, and the distance between the eyes and the page is greater with the upright position.

Another important point is as to whether the base line is horizontal or oblique, the left end lower than the right. If the latter is the case, the head will be bent to the left and the left eye is nearer to the page than the right. The shoulders may then readily follow the same direction, and the result may be an unhygienic posture.

A seemingly unimportant detail may often have far-reaching effects. It has already been mentioned that the penholder should not be grasped too near the pen point. Let us suppose, however, that it is held near the point; immediately the head must be bent to the left to observe the writing, and if the head be bent in this direction, the whole body will sooner or later fall out of position. Unfortunately, this point has not been sufficiently observed in the comparative tests, and the investigations are for that reason not as convincing as they might otherwise be.

It is evident, however, from Schubert's experiments that vertical writing is superior to the oblique because it does not cause the head to be bent to the left.

He has proved that as the writing progresses there is a tendency for the base line to approach that position where the writing line falls into the plane of vision. This point is made clear by a comparison of the two styles of writing. If we lay a piece of ruled paper straight in front of us and commence writing in the vertical style without moving the head to the left, the base line is then horizontal. Let us imagine the plane of vision as extending through the base line and the point of fixation. In this case the base line will obliquely cross the writing line if we imagine the base line advancing down the plane of vision. Now lay the piece of paper slantwise, keeping the position of the head as before, and make slanting strokes. The base line is again horizontal but it will not coincide with the slanting line. If we imagine the base line advancing down as before in the plane of vision, it will cross obliquely at an angle corresponding to the degree of slant. If we sufficiently tilt the head and with it the base line to the left, the plane of vision will come into such a position that the base line advancing down it will obliquely cross the writing line. Thus to write obliquely it is necessary to bend the head to the left to secure the right position for the base line, vision plane and writing line, and this is Schubert's argument against oblique writing.

Moreover, the tendency of bending to the left is intensified when writing quickly. Vertical writing possesses the advantage of but one position for the paper—directly in front of the writer—while with slanting penmanship several positions are possible, all with a tendency of bending to the left. Grollmuss

in Leipsic has devised a guide like the accompanying (Fig. 41), which is printed on the inside cover page of copybooks. The book is placed before the child so that the heavy line is parallel to the edge of the desk. Schubert, also, has a similar line painted on the desk.

It is clear that vertical handwriting has excellent points, but notwithstanding this, it has not become officially popular and in places where it had made some progress it has again decreased in popularity.

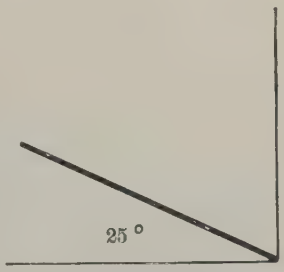

FIG. 41.—Guide line for writing used by Grollmuss in Leipsic.

The effect upon posture of the slanting penmanship is less noticeable in the beginner who writes slowly than in the pupil who writes rapidly. We can readily see why the oblique writing runs off the pen in a flowing manner when we put a piece of paper before us and swing the arm freely or the hand from the wrist. Then the pen describes a smooth arc mounting from left to right, whose radius is the distance between the point of the pen and the spot where the ball of the hand touches the desk. The tangent of the chord of that arc mounting up from left to right is the slanting writing line. For rapid writing such a line is easier to make than a straight one. For upright writing we are obliged to shorten the hand itself in making strokes and to raise the whole hand and forearm oftener as the writing proceeds; this means more muscular work than is

required in slanting writing. Hence the slanting penmanship is better adapted for rapid writing and for this reason, perhaps, it is in almost general use now, whereas in former times upright writing was in favor, as is proved by old manuscripts and paintings.

Handwork.—Sewing and fine handwork may be harmful if the light is poor or the position is incorrect. Great care must be taken to see that the pattern of the work, its color, fineness of finish, and the length of time the pupil spends over the task, shall be such as not to cause an inordinate strain upon the eyes and muscles of the body. When white embroidery, for instance, is done on a white ground or black on black, especially in artificial light, the eyes fatigue rapidly. The female sex is particularly prone to this type of fatigue called accomodation asthenopia, which shows its symptoms in pain over the eyes, headache and dizziness. Beginners in sewing, stitching, crochet work, etc., should, therefore, use rather coarse materials, and later on also no work should be undertaken which is not discernible at a distance of 30 centimeters from the eyes.

Domestic Science.—In the department of practical household arts it must be emphasized that the kitchens where the girls learn to cook, should be well aired, have plenty of daylight, and the rooms for household work in general should be as far as possible free from dust.

Manual Training.—Manual training for boys originated in Finland. It has become widespread in all the north European countries, and is steadily gaining in favor in central Europe also. Our present point

of interest in it is wholly hygienic. The work rooms for manual training should above all be bright and airy, free from dust. Sandpaper for polishing wood should not be used and there should be no foul odors, such as arise from boiling glue. The glue must not be boiled in the working room but in a niche in the

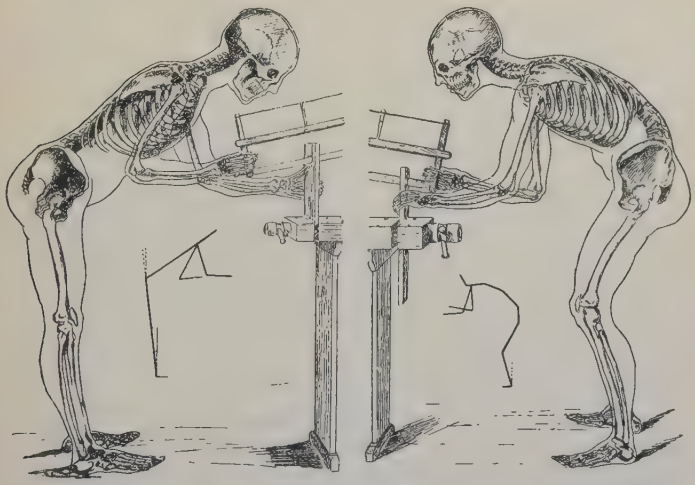

FIG. 42.—Good (left) and bad (right) postures at shopwork. Note the main lines of the body as shown by the diagrams.

wall with an outlet to the chimney. Of special concern is the position assumed by the children during their work; of this Mikkelson of Copenhagen has made extensive studies. The aim should be an erect position, with the chest expanded, the normal curves of the spine maintained, and the internal organs not cramped. The two figures in Fig. 42, and especially

the small diagrams to the side, illustrate good and bad postures.

With respect to training for ambidexterity which of late has been much discussed and advocated, there does not appear to be much to be said in its favor; much time would be wasted in trying to teach the child to write with both hands. The hours so spent might be more profitably used, for instance, in outdoor exercise. Man is not, on the whole, bilaterally symmetrical, as the recent studies of brain functioning have proved in one direction, nor are any of the vertebrates strictly symmetrical. Just how far asymmetry is the result of one-sided activity, it would be difficult to demonstrate.

Gymnastics and Play.—Gymnastic exercises and active play are of the greatest hygienic significance in the life of the child. Their physiological value has been set forth in an excellent way by F. A. Schmidt of Bonn (Germany). The Swedish gymnastics characterized by their slow movements are now advocated with success even in countries like Germany and Austria where the system was formerly looked on with disfavor, since the German *Turnen* is characterized by the opposite kind of motion, brief, spasmodic muscular movements. The latter has its fine points as well as the Swedish mode of gymnastics, while both systems as well as skating, swimming and walking are excellent exercises, especially as they mean time spent in the open. These sports not only promote increased breathing and heart action, but they also afford the eyes opportunity to enjoy long range vision.

During the physical exercises, the children should wear loose-fitting garments, and should carry no pencils or other sharp objects from which they may receive injuries. Care should be taken to avoid shocks to the body; for instance in cold weather, violent exercises should not be undertaken immediately before the children leave the gymnasium. Outdoor play in a strong wind may not be hygienic; in any event, in cold weather children should be cautioned to put on their wraps when play is over, and not to sit on the ground. It is undoubtedly a fact that new games are more fatiguing than those with which the children are thoroughly familiar. As a rule, active play which involves free, joyous running about and jumping makes a stronger appeal than do organized gymnastics without apparatus. Older children like the stimulating competitive games which require decided effort. The only objection to some ball playing is this, that it demands little change of place and gives undue development to one arm. It is to be recommended that in football it should devolve upon the boys themselves to control and if necessary exclude their rougher companions.

Big, strong fellows who make fun of weaker, timid companions should not be tolerated; bashful children must be especially invited to join in the games and encouraged in every way. Care must be taken in regard to the play or physical exercise of children who are convalescing from an illness. A sharp watch should be kept against overexertion and when a child begins to breathe laboriously, complains of a rapid heart or pain in the side, if the face becomes flushed or

very pale, or if he suddenly becomes clumsy when performing simple tasks, he should be excused immediately from further exercise. Children who can not take part in the exercises because of a passing indisposition should not be stationed in a draughty corner to watch the gymnastics of the others, but should rather be sent home.

Many children have physical defects which do not permit of strenuous exertion. Such disabilities as heart disease or a tendency to hernia may escape the eye of the layman, but they emphasize the need of a medical examination before children are admitted to the gymnasium. Lastly, a point must be made in favor of a different exercise curriculum for girls, because of their more delicate build and weaker musculature.

It was formerly a general idea that physical exercise should alternate with mental labor, because physical exercise was interpreted to mean recreation; but we now understand that any severe exertion is work, and that recuperation from exertion of any kind requires rest. After hard play or after learning a new gymnastic exercise which requires will power and attention, rest is needed just as much as after scientific brain work (cf. p. 75). It is not possible to demonstrate here the very interesting scientific studies of Teljatnik in Odessa (Russia) or Oker-Blom in Helsingfors (Finland); but one experiment, that of Keller in Winterthur (Switzerland), must in justice be mentioned. Keller tested among others a fourteen year old boy with the ergograph to discover, if possible, the exact effect of gymnastic exercise. The test was

made at two separate times, first after a lesson and a rest period followed by twenty minutes of gymnastic movements, interrupted by brief explanations. In this case the arms were not exercised. The boy was then asked to read. On another occasion the boy was given a twenty-minute reading lesson first, and this was again followed by reading. The ergograph tests were taken every twenty minutes. The results were better for the two consecutive reading periods with-

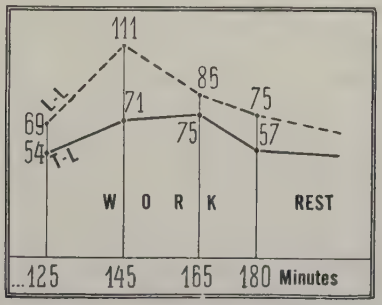

Fig. 43.—Ergograph tests made by Keller of Winterthur, Switzerland, to determine the effect of physical exercise on mental activity. T-L = work done after a period of gymnastic exercises followed by a reading lesson. L-L = work done after two consecutive reading periods.

out opportunity for exercise or rest between than when there was physical exercise followed by reading. Fig. 43 shows the exact work done. On the lower line are the time periods, and the two curves represent the work done with the ergograph—the line T–L after gymnastic exercises and reading, and L–L after two consecutive reading periods. The ergograph results are read relative to the scale of 100.

This and other experiments show graphically that

after vigorous bodily exercise rest is needed as much as after mental strain; and the experiment illustrates also that an hour of gymnastic work interposed between periods of mental activity must not be regarded as "recreation." If children are to grow up strong and healthy, they must have physical activity, that gained from vigorous play and gymnastics, but all such exercises demand corresponding rest. From this standpoint it must be admitted that the curriculum of many a school must be considered a failure, because it does not promote the physical health of the children.

Singing.—Singing demands increased work of the lungs, both in inspiration and expiration. Hence it follows that during the singing period the air of the room must be pure and especially free from dust. It is well to use a room which has not been occupied during the preceding period, and this is especially desirable in winter, when thorough ventilation by help of windows and doors is difficult. Fatigue from singing depends upon whether the songs are familiar or new ones are being learned. It is well to have the children stand when singing, as the internal organs have greater freedom in that position of the body, but long continued standing is very fatiguing, for which reason, the singing period should be interrupted by pauses during which the children are allowed to sit; these pauses might be used for explanations. The singing should not become a strain upon the children. They should start to sing softly, as the child's voice is not strong; shrill, forced singing should be discouraged. It is practicable, where children are able, to have them take part in two-voice singing. Those who have colds

should not sing, nor those whose voices are changing. The dress at the neck should be loose and comfortable. Singing should never be attempted when walking against the wind, going up hill, in dusty places, in a raw or smoky atmosphere, nor immediately after severe muscular exercise.

This section has been limited to discussing the hygiene of a few selected subjects, because, as already indicated, reliable data on which a sound judgment could be based are not as yet available for all school subjects.

4. Homework, Examinations, Etc.

Homework.—Homework is too important from the educational standpoint to be dispensed with, but if not properly regulated it may be detrimental to the health of children. In the elementary schools only such homework should be assigned as the children have been prepared for in the classroom, and not before a proper method of studying has been learned in school, which includes the inculcation of good sitting, reading and writing habits. We are of the opinion that the homework generally assigned in elementary public schools is not excessive, although the regulations existing in some cities with respect to this point seem to indicate such an undesirable state of affairs.

The industrial work of children is a sad chapter in history which lies outside the scope of this book; and we can only refer the reader to the excellent work of Agahd in Berlin, who has done much to further the rights of German children in such matters. The work

done by Leubuscher in Sachsen-Meiningen shows the aid that can be given by the school physician in this respect. Further, nurses ought to be a great aid in this direction.

The conditions of compulsory homework are somewhat different in various secondary schools. Here the complaint of too much work has been and is so frequent that school boards in various countries have felt obliged to pass regulations stipulating the length of time beyond which the pupil shall not be taxed. That such regulations are not, however, strictly adhered to is evidenced by the remark of the Prussian Minister of Education, von Gossler, in an address made by him in 1890 before the Prussian legislature: "The number of hours of homework is indeed fixed by decree but all attempts at enforcing the regulations, all efforts toward changing conditions, are futile because the pride of teachers, in consequence of an ambition which is in itself very estimable but which should not be supported, tempts them, particularly in the larger cities to lay greater stress on homework than is in accord with my views." This expresses the situation exactly. It is true, no teacher in the secondary school desires to injure the health of his pupils, but many a teacher in his eagerness to have the pupils shine in his particular subject forgets that he himself is but a link in the chain. Often the true state of affairs is only discovered by interviewing the parents. For more than twenty years in the Grandduchy of Hessen it has been the rule to ask the opinion of parents and reliable pupils concerning homework conditions. A specialization of control by having

one teacher supervise the amount of homework to be assigned in each department, or a single competent supervisor for all the work of the school may avert much harm.

It is, of course, difficult to demonstrate the unhygienic effect of overwork when there is no regular medical inspection concerning health and development. To ascertain the exact effect of homework, Key of Stockholm made a study of ten high schools, accommodating boys of eleven to nineteen years, in different parts of Sweden. The average time spent on homework was computed with the assistance of the parents. His results show that of the total number of 3,968 pupils, the homework of 1,809 covered a longer period than the average time, while 2,159 worked less than the average number of hours. Among the 1,809 pupils, the percentage of illness was 47.9, among the 2,159 it was only 44.7; that is, the group that worked a longer period at home had 3.2 percent more sickly individuals. An analogous investigation made with regard to the 1,873 pupils in all the high schools of Stockholm showed the percentages of sickly pupils to be 56.1 and 50.8 respectively; there were 5.3 percent more sickly scholars among those who spent more than the average time on their homework. Further investigations have shown that those who work the longest at their lessons are often not the dull pupils, but on the contrary, the bright and conscientious who desire to meet their school obligations very fully. The claim that it is the outside work, such as music and language lessons, which tax the pupil unduly can

be made only after we have accurate data on this point. So far as boys are concerned, we can cite the investigation made in Sweden, which covers thousands of pupils. This showed that only one-fifth of the boys had extra lessons which required on the average from four to five hours work per week of the pupil. Gymnastic home exercises were included in the category of extra work.

It is deplorable that such illuminating research studies as are undertaken in Sweden are not made in Austria or Germany, as well as in other countries, for it is, of course, impossible to affirm that conditions everywhere are the same as those that have been cited. The smaller studies which Doernberger and Grassmann have made in Bavaria, however, show that the children there lack sufficient time for recreation, which they require for sound development.

Another point which must be brought out in connection with taxing homework is the fact that children, especially those in the higher schools, do not really digest the matter presented to them. In this respect also Key's investigations afford insight into the difficulty. Patzak of Prague has likewise made scientific researches as to the degree of real understanding which pupils have immediately after they have been taught in school, and finds most discouraging results. It can not be said too often nor with too much insistence that every teacher should convince himself at each step in instruction that the subject has been understood before he proceeds further.

But the teachers as a whole can not rectify all the evils of homework. As already indicated a great

drawback lies in the overcrowded class. This circumstance alone, where the ideals of the teacher are ambitious, is apt to lead to overpressure. Another difficulty may be the zealous supervisor.

Extra Work.— On the whole, extra lessons play but a minor rôle in homework, especially in the case of boys. It is true that with girls the music lesson is a more important factor. Key found that in the secondary school of Sweden 70 percent of all the girls devote on an average one hour daily to music. This finding is corroborated by Waetzold from the statistics of Berlin schools. On the other hand, the work which boys in higher schools do to earn money is often exceedingly taxing, as Roller of Darmstadt (Germany) has shown by the drastic examples which he gives.

Examinations.—Examinations, like homework, are unavoidable, and like the latter, may be injurious to health. The fear of examination is in itself a form of neurasthenia which frequently appears in industrious, well-prepared children.

Above all, the examination question should be quite clear. If oral, the pupil should be allowed to tell what he knows without being interrupted by further questioning which may disturb his train of thought. An exception to this might be made in mathematics. No child should be ridiculed for his attempts. The pupil should not be allowed to remain in ignorance as to whether he has passed the examination or not. The object of withholding this information, *i.e.*, to stimulate the child to renewed efforts, cannot be justified. If the classes are too large and the material to be

covered is too extensive to permit of frequent tests, it is not fair to make the child suffer because of this lack in school arrangements. It is to be recommended that, if possible the examination should come at the beginning of the lesson, before new matters are taken up, so as to relieve the mind of the child.

Written examinations often cause great nervous strain. For this reason, it might be well not to let the pupils know the exact day of the examination, so that they will not worry beforehand and also do less efficient work at the examination.

The written examination should be such that the average pupil can finish within the designated time, otherwise the fear of not having enough time and the strain of hurry will be added to the already existing condition of excitement and anxiety. The tax that examinations make upon children is recognized in statutory previsions made in many countries. In Austria the requirement is that no greater value shall be attached to written examinations than to oral. The same tendency is expressed by the Prussian decree of 1911. It is a most objectionable arrangement for teachers, who can not because of the large number of pupils examine often enough, to depend upon the final examination to decide the child's standing in the subject.

Graduation Examinations ("Reifeprüfungen").— There is a great deal of discussion nowadays about the advisability of graduation examinations, and opinions on this score are divided. We are interested here in the question of the graduation examination being objectionable on the grounds of health, but we can not

answer for all countries—even if we had the temerity to attempt it—because valid conclusions can only be based on exact proof. It is regrettable that with a few exceptions (Leubuscher in Meiningen) no attempt has been made in the various German states for regular physical examination of the pupils in the upper classes during the critical period. My assumption that such examinations, together with the period of preparation which they must entail, must be injurious to health, is based on the researches made in other countries with respect to the examinations given to ascertain the pupils' knowledge of a wide extent of instruction matter. The authorities in this field are Binet of Paris, who examined the applicants for the teachers' examinations; Ignatieff of Moscow who examined pupils of a surveyors school; Iwliew who made an examination of the girl students in a Bulgarian school; Kosinzoff who examined the boys of three of the higher schools of southern Russia; and Bonoff's work with regard to the graduation examinations (*Abiturienten-examen*) in Sofia. The investigations made by these authorities were mostly with regard to metabolic body changes. It can not, of course, be asserted that the conditions in the schools of these countries are identical with those in central Europe, and no authoritative statement can be made without a basis of exact facts. Conditions are different in America, where pupils in the upper grades of the secondary schools have to a certain degree the liberty of choosing their subjects. Prussia has lightened the requirements through the compensation system, and in Austria the

graduation examination has undergone considerable alterations, which diminish its disadvantages.

Overwork.—There can be no doubt that classwork, homework and examinations are a severe tax upon the health of children and that this tax may readily exceed the normal limit. So as not to reach the danger point, the child must above all have sufficient sleep, for as has been already mentioned, he not only needs to replace tissue, but he also needs to grow. During sleep the tearing-down processes are diminished and consequently there is opportunity for new growth. In this connection, the valuable investigations of Key of Stockholm must again be cited. He found that the time of sleep for the pupils in the high schools of Sweden was one hour, and in some classes much more than one hour, less than the physiological requirement. This finding does not apply to city children alone, for his investigation included 13,627 children in all parts of Sweden, that is practically all those attending the higher schools. The statistics of these eleven- to nineteen-year-old pupils show that the period of sleep is progressively less the higher the grade a pupil occupies for his age. The explanation for this loss of sleep can not be sought in the home; the greater demand of the school must be held responsible. On this point, Schmid-Monnard has furnished admirable data in an investigation made in Halle (Germany). By tabulating the period of sleep for the elementary school children of that city and comparing it with the sleeping time of children of the same age in the higher schools, he found a curtailment among pupils attending the latter. Leubuscher instances the fre-

quency and seriousness of nervous disturbances in the upper grades of higher schools as due to mental strain. Chlopin of St. Petersburg bases similar conclusions on an investigation of 104,696 pupils in the secondary schools of entire Russia.

Out of the mass of statistics which Key has given us and which is so comprehensive as to make his conclusions of real value, we wish to make application of one fact—the relation between sickness and development. That the increase in body weight is not a constant one for all ages is a well-known fact, but Key has also demonstrated a decided increase in sickliness during the years of school life, and he finds that this sickliness curve has a pronounced relation to the weight curve. This fact is significant for the school or, more correctly stated, it ought to be significant. If, for instance, as was the case in Sweden, it is found that there is a decided increase of sickliness or a weak state of health at a certain age, and a corresponding decrease in growth, that period should be regarded as one of lessened resistance, and care should be taken to ward off all harmful influences. There are, however, no cases on record where a curriculum has been modified to meet such conditions; not even an attempt has been made in other countries to verify Key's findings. It must be emphasized that the school has a higher function to perform than merely to give instruction, and that improvement of existing conditions must be based not on theory but on a firm foundation of observed and verified facts.

Punishments.—Punishment for wrongdoing can never be quite eliminated from the school, and the only

question that remains is, what forms of punishment are least objectionable, hygienically considered? We must consider four types—censure, punishment work, depriving the child of freedom, and corporal punishment. With regard to the whole subject of punishments the medical inspector may be of great help, for, as is frequently the case, the cause of mistakes may lie in certain pathological conditions of the eyes, such as farsightedness, astigmatism, strabismus, rather than in inattention. The same may be said of defects of hearing, especially if the difficulty is not constant but intermittent. Some children void urine involuntarily, others can not control involuntary twitchings of the muscles. Mistakes are also frequently made in judging the mentally defective. Certainly no humane teacher would desire to punish a child who because of physical or mental disabilities is not responsible for his mistakes.

The work assigned as punishment should not be such that the child is deprived of necessary recreation, and when he does remain in school during play time it should be under the supervision of a teacher, for it has been found that unsupervised children frequently fall into bad sexual habits. The brief recess periods should never be forfeited. To stand for a long time is extremely fatiguing, and little children should not be punished in this way for longer than ten minutes; the punishment of standing through the whole period of the lesson is also too severe for larger children. It is dangerous to put children in the cold halls in winter, while that refined kind of horror of lying flat on a hard floor or standing with arms

extended belongs neither in the school nor the home.

Corporal Punishment.—The most difficult question arises with reference to corporal punishment. It can not easily be dispensed with altogether, where it has once been in practice, because of the supposed disastrous effect upon discipline; badly brought up and unruly children will immediately assume an aggressive attitude. But notwithstanding these difficulties which are those of transition, the tendency should be toward doing away with whipping altogether. Not to mention the injury to the dignity of the child, facts can be cited from countries where corporal punishment is still in use, which leave no doubt whatsoever that this type of punishment is responsible for some horrible malpractices, the majority of which never come before the public. It may happen that even mild whippings lead to serious results and death, or whipping may excite sexual feeling and attract teachers with sadistic tendencies, as for instance in the sad case of Dippold. It is possible to give a long list of the restrictions which prevail in countries where corporal punishment still persists, for instance, that the headmaster shall be responsible, and that the school physician and the school director must be consulted, also that girls shall be spared, and that no children beyond a certain age shall be punished. All these provisions are made for the purpose of limiting corporal punishment and averting the possibility of the child being whipped in anger. Another indication of the tendency to do away with corporal punishment is the preference shown for teachers who can achieve

satisfactory pedagogical results with the minimum number of whippings. In Finland, for instance, while corporal punishment in the school is not prohibited, it is never practised because public opinion is against it. In Belgium, France, Hessen (Germany), Japan, Austria, some cantons of Switzerland and most of the United States it is prohibited. It can readily be seen that in countries where whipping still prevails, teachers are loath to part with it, especially in classes of from eighty to one hundred unruly boys. In such a case a tired, irritated teacher can hardly be blamed for resorting to physical force, but the question of the wisdom of such acts—it may be that the wrong child is whipped—still remains open, and it is very doubtful if children are morally improved thereby. Very likely, if the teacher had only half the number of pupils, that is forty, he would be very ready to dispense with corporal punishment. It is undoubtedly a fact that many whippings can be attributed to just such circumstances as those cited above.

Where corporal punishment is practised, the following points should be observed. The teacher should not box or pull the ears of the pupil; he must not hit the child on the head or neck, nor use his hand, a book, a ruler or a heavy stick; he must not pull or push the child about, or punish him at his, the child's, desk. To spank the child on that part of his anatomy which seems best able to bear this punishment may excite sexual feeling. Many aspects of the subject need to be considered, and even when corporal punishment is hedged about with restrictions it is a source of distress to all concerned.

Again, in the public schools of large cities we find children who have become vicious and unruly through neglect at home. Such need first of all pity, rather than punishment. It is probable that the practice of whipping in school would be greatly lessened if such unruly children could be segregated in special schools with small classes—which might obviate the necessity of later sending them as delinquents to reformatories. It is, of course, better still to prevent such a condition of affairs by the enactment of legislation concerning the duties of parents and by such adequate measures as institutions for ill-treated children, but the time is not yet ripe nor are the means at hand for the realization of these ideals.

Pupils in secondary schools should not be subject to corporal punishment. The dishonor attending correction is felt very keenly during these years, especially at the beginning of puberty, and it may be disastrous. Even threats of corporal punishment have been known to have had bad effects. Lentz cites the case of a pupil who committed suicide because he was to be whipped.

School Suicides.—It is probable that while the immediate cause of these school suicides may be a feeling of injured pride, fear of punishment, dread of examinations, or unhappy love, the underlying cause is pathological, and the tendency may be an inherited one. The suicides of school children, especially of boys in high schools, are far too frequent, as Eulenberg has shown with regard to the schools of Prussia and Chlopin for those of Russia. It behooves the school to realize this situation and to do everything in its power to avoid such disasters.

Other Punishments.—To ask a child to be the bearer of a note reporting his delinquencies to the parents or to bring a message of reproof, means simply to lead him into temptation. The psychic influence of this upon a sensitive child whose parents are severe may affect his health unfavorably, not to mention the moral danger of lying and subterfuge.

The kind of punishment which might really be effectual is to deprive the child of some pleasure—praise, play, swimming, etc., although at present the school offers small opportunity in this direction, for school pleasures are few. The prospect of being deprived of the shower bath has been found to be an effective pedagogical measure in the schools in Munich, and analogous cases are reported from English schools when children are not permitted to participate in the sports of their companions.

Vacations.—That vacations are beneficial to health is a well-known fact, though we lack scientific information as to the desirable length and distribution of vacations in the school year. The findings of investigators in Denmark, Germany, and Scandinavia are in general accord, *i.e.*, that the children's gain in weight during these free periods is proportionately greater than during other times, although in connection with this statement it must be said that we do not yet know what part seasonal changes play in the growth of children at various ages, nor do we know for large numbers of children the comparative increase in weight by months of those in school and those who are free. To solve the last-mentioned problem, investi-

gations need to be conducted in a country where great numbers of children are still out of school.

Summer Vacation.—That a long summer vacation is beneficial from the pedagogical as well as from all other standpoints is shown by an example from Russia. In that country during the cholera epidemic of 1891, the summer vacation was lengthened by two weeks for 37 boarding schools. The results with respect to examinations and general attainments for the following school year were found to be so satisfactory that it was resolved thereafter to adopt the longer vacation. This instance likewise illustrates the value of the experimental method in education. In advocating the experimental method we do not, however, mean to say that every school should try a longer vacation one year and a shorter one the next; this would be a contradiction of the word "experiment." If, on the other hand, a large number of pupils, at least 10,000, in a selected number of schools in both city and country, were studied with respect to the effects of a lengthened vacation upon psychic development, condition of health, and school attainments, in comparison with a like number of children whose free period remained unchanged, really valuable data might be obtained. The best time for the summer vacation naturally varies with climatic conditions. In the northern hemisphere the months of July and August are preferable because of the high temperature and also because the long days of those months permit the children to be out-of-doors the maximum number of hours. Schuyten of Antwerp, in studying over 600 school children from seven to fourteen years of age, with respect to

their spontaneous attention to reading in relation to varying outdoor temperatures, found the lowest percentages during July (August and September were vacation months and no observations were taken); he found that the attention curve rises from October to January and then descends till July. The long vacation should at all events come at the end of the school year. When this is not the case, the vacation will not be of the greatest benefit because of the anxiety which some children will feel about their work.

Mid-term Vacations.—In addition to the summer vacation, a number of mid-term intervals must be considered. The most desirable time would seem to be at the end of December and beginning of January, and the latter part of March or early in April. It is better not to regulate the vacation according to the date of Easter which changes from year to year, and to allow only the church holidays at Easter. The period from March to April is the time of highest morbidity in the year, and hence peculiarly significant for a vacation, so that unfavorable influences may be mitigated as much as possible.

This statement is based on statistical data obtained from the five children's hospitals in Vienna and covers an analysis of the records of 40,000 children of all ages up to fourteen years (1898 to 1904). A rising morbidity from the opening of school in September to the end of the calendar year was observed, with a high point in March and a maximal rise in April. In the figures of Zirngast, of Mährisch-Schönberg (Austria), who studied the absence records of eleven to fifteen-

year-old children in the four lowest grades of the higher schools for a period of twelve years, there is a steady ascent in the curve from December to January, and the greatest rise in March. Lobsien found that in Kiel (Germany) where the new school year begins in April, the greatest number of absences also occurred in March; there was a decided drop in the absences for April.

The great significance of rest on the seventh day is hallowed by religious custom. Sunday should not only be a day of freedom from school, but the demands of the week should be so regulated that it shall not be necessary to do any home work on that day. This may also be said of vacations. During the summer especially, children should not be required to do any school work, even that disguised in the form of designated reading. Such tasks spoil the vacation for many children, and moreover small educational benefit is derived from this practice, for the children will usually leave the work until the last minute before school. Much has been forgotten during the vacation, and it is not fair to expect that at the opening of school the children shall be as familiar with the subject as they were at the close of school. The tasks assigned for the Christmas and spring vacations should not exceed the demands ordinarily made for the next day.

Suspension of School on Warm Days.—Suspension of school during very warm afternoons has become a general practice in Europe, since it was officially recognized in Württemberg (Germany) in 1870; the custom existed in Dresden and Leipsic even in the middle of the century. No specific temperature of

excessive heat can be given, for much depends upon local conditions. Thus in a small town with only twenty pupils in a room which opens to the east, the school work may proceed with comfort, even though the day be hot, while on the same day, conditions would be unbearable in a city school with sixty pupils to a class room opening southward on a street.

Vacation Colonies or Camps.—The vacation colonies are a form of school welfare work most worthy of encouragement. This work was started in Copenhagen in 1854 for poor children in need of fresh air, who were taken to families in the country; but, of the vacation colony in its modern sense, Bion of Zürich is the originator. He started in 1876 to take groups of city children in charge of their instructors out to the country. For small camps, the family plan of living is very desirable. Before starting out, the children should be examined by a physician, weighed, and then re-weighed at definite intervals during their stay at the camp, so that those who show no gain may be especially cared for. Such deficient children should not be permitted to take part in long tramps; they should be allowed to remain only a few minutes in the water, should rest after dinner or be sent to bed earlier than the others. The régime at the camp should include a good breakfast eaten after some exercise, a good dinner in the early hours of the afternoon, and an early, light supper with soup and milk dishes, but no meat.

The finest vacation camp in Europe is on the shores of the beautiful Lake Abersee, where 500 Vienna boys, eleven to twenty years of age, of the Latin and

modern schools, have camped since 1911 during their summer vacations. The colony covers an area of 400,000 square meters and is open from the middle of July to the middle of September. Any friend of youth who visits the romantic Salzkammergut should pay a visit there.

Excursions in Vacation.—Vacation picnics, vacation sports, and holiday trips, are admirable institutions for city children. It need hardly be said that on these occasions and also in the vacation camps, none of the children, not even the older ones, should be permitted to partake of alcoholic beverages. Milk is a suitable drink. If the drinking water is not known to be absolutely pure, it should be boiled and a little lemon juice or tea added. In this category of vacation activities also come the extensive walking tours of children accompanied by their teachers.

Recreation Day Camps and Open-air Schools.—The recreation day camps were first established near Charlottenburg in 1902 and arose out of the Red Cross recreation center work started in 1900. They have now spread over the entire world, and have led to the establishment of recreation piers, roof playgrounds, etc. These day camps are usually located in a restricted wood near the city and on a car line; on the grounds are a number of huts (barracks). The children are taken to the camps in the morning and return to the city at night. In the forest school (*Waldschule*) of Charlottenburg, near Berlin, the children have received regular instruction since 1905. Open-air schools are now a growing educational feature in America, Germany, England and Austria.

5. Boarding Schools

Life in a boarding school offers many health advantages, especially to pupils of the higher schools in the large cities, but also some grave disadvantages. The advantages are that there is a better division and use of the pupil's time than at home, physical exercise is on a better basis, and the accessibility of physicians who make regular examinations of the pupils' eyes and teeth, keeps them in better condition. These advantages apply only to good boarding schools. The disadvantages, on the other hand, are the rapid spread of infectious diseases and sexual irregularities. The ideal arrangement for pupils of the higher schools would be to combine the advantages of the home with those of the school. That is, if the child could go in the morning to a good school, remain there for the entire day, and return to the home at night, the disadvantages of the boarding school would be obviated, while the advantages remain. In this way, the home influence would not be lost. Groups of small lodging houses, not accommodating more than twenty pupils and each house in charge of a married instructor, would be most desirable for boarding schools. The relationships thus established would be those of a family with many children, and the pupils would escape the disadvantages of overcrowding.

What has been said about the construction of school buildings applies in general also to boarding schools. In addition, of course, certain sections must be set aside for more personal use, for a kitchen, dining-room,

study rooms, hospital accommodations, and sleeping quarters. The latter offer the greatest difficulty, for while with small separate bedrooms the possibility of conversation after retiring is avoided, they make supervision of the individual child more difficult. Ventilation in small rooms is also apt to be deficient, and the difficulty of cleaning presents itself. Common dormitories can be more readily supervised, and are easier to ventilate and clean, but in them the pupils' freedom as to intercourse is less restricted. An adjustable screen by the side of each bed with a curtain which can be drawn when the pupil is dressing, undressing, or washing, protects modesty. The beds should be at least an arm's length apart. Alcoholic drinks should be absolutely excluded from boarding schools.

Open Air Boarding Schools.—Special reference must be made to the open air boarding schools in the country. The first of this type, called "The New School," was started by Reddie at Abbotsholme, Derbyshire, in 1889 for boys. In Germany the first appeared in 1898; later similar schools were started in Austria and Switzerland, and now we have such institutes for girls as well. The chief hygienic characteristics of these schools are—simple, plain food (alcohol being absolutely excluded), regular bathing, sports, and the alternation of mental with physical work. The latter includes working in a garden, field, and workshop. To harden the physique of the pupils they sleep frequently in the open air. Intellectual work is restricted to the morning hours. The educational ideal of these schools is to awaken self-reliance

and to establish closer companionships between teacher and pupils. It has been reported that in the zealous application of their rules, in sleeping out of doors even in very cold weather, in exposing the limbs of the children to the cold, these schools have gone too far; but it can not be denied that the training which children receive in institutions of this type is far superior to ordinary school training, and not only with respect to physical health. Unfortunately, such schools can be available to only a small proportion of the school population.

III

INSTRUCTION IN HYGIENE

It is clear from the foregoing discussions that a systematic and incessant campaign of school hygiene cannot be carried out if the teacher within the school is not informed on these subjects or does not know how to put these ideals into practice. The school physician, of whom mention will be made later, can not replace the teacher in routine matters of hygiene; the former visits the school only at definite times, while the teacher's influence is continuous. Hence it is absolutely necessary for the teacher to possess at least some specific knowledge of school hygiene. It is the duty of the teaching profession to call attention to hygiene requirements, so that blunders will be less frequent when new school buildings are erected, or old ones are rebuilt, but a wider and more fertile field for the propagation of hygiene ideals is the classroom where a consistent regard for these ideals is demonstrated daily. Another avenue for the furtherance of school hygiene lies in scientific research work for those teachers who are equipped in this direction and who can devote sufficient time to the work. The hygiene of instruction especially offers numerous problems for investigation. Of the greatest individual and social significance is the instruction of the children in matters of hygiene. Talks with parents concerning the rearing

of children, and discussion of unhygienic conditions in the community, are other effectual means. Finally, a not to be despised advantage of this knowledge is the benefit which it may be to the teacher himself, in helping him to guard his own health in an arduous profession.

Hygiene in Training Schools.—It would be especially useful if matters of school hygiene were included in the last year's curriculum of the training school, so that the young teacher may have not only a theoretical, but also a thoroughly practical knowledge. It would be of still greater advantage if the training school could offer a variety of conditions, in order that the teacher may be instructed how to meet the situation with regard to varied school conditions, as found in both city and country.

It is also most desirable for the teacher to have sufficient medical knowledge to recognize the first signs of disease, particularly the contagious diseases of childhood, so that in suspicious cases, when a child complains of feeling ill, or has a sore throat, difficulty in swallowing, headache, coughs continually or sneezes without mucous secretion, or has fever, he can be sent home at once for medical examination. In localities where many cases of cholera or typhoid fever have occurred, a knowledge of first symptoms and what to do when they appear, may help to prevent epidemics.

The most suitable person to impart instruction in personal and school hygiene in the training school is undoubtedly a well equipped physician—a demand which is more easily made than fulfilled, for there

seems to be small desire on the part of physicians to prepare themselves carefully in the way necessary to fill such a post; hence the work must often be done by teachers. If the position of the school physician at the higher schools were an official one, *i.e.*, if in addition the physician were the physical director in charge of the physical training of the school, or if this post should not offer enough occupation, perhaps also the natural history instructor, the difficulty might be obviated and the physician would be brought into closer contact with the school. A paragon institution is the Department of Hygiene in the College of the City of New York, where Storey is doing excellent work in medical inspection, physical education, and instruction in hygiene.

Teachers and physicians of the old order who have had no scientific training in hygiene, are not as a rule favorably inclined toward the "innovations" of hygiene. If, therefore, a young teacher who is well prepared on these subjects takes up his work with great enthusiasm in a school where the principal and most of the teachers belong to the old régime, he will seriously jeopardize his interests if he tries to introduce reforms too quickly. It is well for him to be guarded in his actions, to feel his way, gaining first the trust and confidence of a number of his co-workers before he attempts to put new principles into effect. On the other hand, it goes without saying that the teaching profession also includes many who have grown gray in the service and who keenly welcome the new; in general, it can be said that the teaching profession is distinguished by an eagerness to widen its fields of

knowledge. The reading of literature on school hygiene and the attendance at lectures on the subject demonstrate the extent of this open-mindedness, and the older teacher possesses this great advantage over the young instructor just out of the training school—he is in a position to correlate the theoretical and new with his personal observation and ripe experience.

Hygiene in Elementary Schools.—The school offers a multitude of opportunities for the practical demonstration of hygienic living; the daily conduct of the teacher in this respect as in others should serve as a model to the children. Instruction in personal hygiene should be a recognized school subject. A definite number of hours during the year should be devoted to teaching the essentials of right living as it concerns food, work, care of the body in all its parts, safeguarding it against contagion, etc. This instruction may be supplemented by definitely planned and suitable reading. Little books of health rules, of which the first to be published in Germany was put forth by the teachers' association of Berlin, and of which many different kinds can now be obtained, are useful in helping the children to gain a clear idea of fundamental principles. Placards with maxims in verse form which appeal to the eye are useful for the schoolroom; the children read and remember the hygienic lessons which they convey, especially if attention is drawn to the motto as occasion may demand. The older folklore may be lacking in proverbs which express the ideals of the modern day, but it is not difficult to meet the need by creating new maxims. Such simple rhymes as the following may be effective:

When before the board we sit
Only cleanly hands are fit.*

The oldest instance of instruction in hygiene in public schools is furnished by Eichstadt (Germany) which included this provision in the school regulations of 1785.

Hygiene in High Schools.—What has been said up to this point about instruction in hygiene applies particularly to the elementary school, but the secondary school also has its own problem in this respect. In the first place, it is essential for the teacher in the secondary school to be thoroughly well equipped in hygiene. His schoolroom duties are largely identical with those of the elementary school teacher, but of him special discretion is demanded because of the intensity and quantity of work required of pupils in the higher institutions.

In high schools we find those who desire to qualify for teaching positions. Hence it is desirable, as is customary in Austria and in some parts of Germany, to provide special lectures in hygiene for high school students. The interest shown among high school teachers has on the whole been more lax than in the elementary school, and yet the long, hard tasks of the higher school, which fall upon the pupil during the pubescent period, make it imperative for the teacher never to lose sight of this larger viewpoint of health. Matters of health must be taken seriously. During the high school age, as well as earlier in their school career, children need special instruction in

* Vor dem Essen merk' die Regel:
Wasch' die Hände, putz' die Nägel.

hygiene. Such instruction is particularly significant for the high school, not only because the importance of community hygiene is then beginning to be appreciated, but because the pupils of the higher schools will eventually compose the greater part of the class which will be instrumental in supporting the hygienic ideals of the community. In view of the significance of the subject, its introduction into the high school curriculum in Europe has frequently been agitated; but it is clear that where it does not replace another subject which is dropped, the extra work will only mean an additional burden upon the pupil —an unhygienic procedure. Therefore, for the present we must content ourselves by stimulating the interest of high school teachers, to the end that matters of hygiene may be embodied in the books and discussions on various other subjects. The wise teacher can then make incidental mention of hygienic points as opportunity may offer. Or, it may be possible for the upper classes to curtail other courses, for instance those in nature study, and substitute hygiene, proceeding gradually with a view to training future teachers. When the instructor in hygiene is a physician, he should be thoroughly trained in school hygiene.

Of the various subjects included under hygiene, the use of alcohol and tobacco, and sex problems require detailed discussion

Alcohol.—The results of scientific study leave no doubt that alcohol, even in small quantities, is injurious to children. Alcohol is a poison, and its use by children should be prohibited. The statistics in

secondary schools of delinquents and the studies that have been made into the causes of insanity, as well as the frequent occurrence of venereal infection among students who use alcohol, all show to what extent the misuse of alcohol may lead. The campaign against this poison is an unquestionably justifiable one; its significance is still underestimated by many. That the alcohol problem concerns the school population is witnessed by the prevalence of the evil practices found among German high-school students; these practices are copied and carried on by the pupils of the lower schools in their secret societies, and so the evil spreads. The vices thus propagated are a blot on the morality of Germany and Austria. One of the saddest sights is the teacher addicted to drink.

Theoretical teaching alone will not cure the evil, and the influence of the school must extend to the hours spent out of school as well, to the extent that alcoholic drinks may be excluded from the social gathering of students and the midnight carousals be condemned by public opinion. The school may help by prohibiting the use of alcohol in any form in its recreation camps, on walking tours, etc. The teacher who in the interests of his pupils, because of the example of abstinence which he sets, is willing to sacrifice his own pleasure is doing a genuine service to children.

Tobacco.—Tobacco, also is to be condemned for school children because of the many injurious results that arise from its use and because of the manifest tendency for the habit of smoking to spread among ever younger groups of pupils.

Attempts have been made in many countries to combat the evils of drinking and smoking by legislative enactment. In the United States, for instance, the act of Congress passed May 20, 1886, and which is in force in all states and territories, provides that every individual shall at some time of his life receive instruction in hygiene, with special reference to the effects of stimulants and narcotics. At least 20,000,000 children come under the influence of this law.

Sex Hygiene.—Another important and difficult problem concerns the instruction of the young in matters of sex. Next to tuberculosis, alcoholism and venereal infection are the two greatest evils—and preventable evils—which threaten the welfare of the human race. Masturbation during early childhood which is widespread among boys has injurious effects and prepares the way for other evils. The school must do its part to stamp it out, though it is very difficult to attack the subject directly in instruction, and the home must take practical measures to help. Much may be done through discussions at parents' meetings. In a number of German cities it has been the custom to deliver lectures* to those graduating from the higher schools on the dangers of too early sexual intercourse, but these measures in a remarkable number of cases come too late. An adequate amount of physical exercise with the opportunity for such exercise, is one of the most important preventive measures. The city of Helsingfors in Finland, through

*Such lectures have been given by von den Stein in Düsseldorf, Sternthal in Braunschweig, Brennecke in Magdeburg, Stephani in Mannheim, Germany. They can be obtained in printed form.

the efforts of Oker-Blom, has taken the longest step forward that has yet been made in sex instruction, by imparting information on these subjects to graduates of the elementary schools.

Girls of a suitable age should be instructed by women teachers about the significance of the monthly period and its hygiene. Such instruction is sometimes difficult in schools for girls where the teacher of hygiene is a young physician; but the difficulty can be obviated by putting this particular work into the hands of a woman teacher or by sending to the mothers of girls suitable printed matter, so that the mothers themselves may enlighten their own daughters.

IV

SCHOOL DISEASES AND MEDICAL INSPECTION OF SCHOOLS

Contagious Diseases.—School hygiene has arisen out of the need for correction of certain physical conditions which have been looked upon as intimately connected with school life. It is a universally recognized fact that such acute, contagious diseases as scarlet fever, diphtheria, measles and whooping cough are most frequently contracted in school. This is, of course, due to the fact that in the schoolhouse we find large numbers of children who are susceptible to these diseases, which are carried from one to the other in daily intercourse. The carrying of disease is a difficulty of the school which can never be wholly overcome, but it can be minimized to a considerable extent by preventive measures.

Well-lighted, adequately ventilated and clean schoolrooms, recreation rooms, playgrounds, small classes, shower baths, etc., are important means for the prevention of diseases; indeed, if their hygienic importance were fully recognized, it would perhaps not be as difficult as it is at present to secure sufficient appropriations for their maintenance. The particular ways in which diseases may be transmitted—by the common drinking cup, by expectorations, the use

of slates, kissing, etc., have already been mentioned. Poverty also plays a great rôle. In the sunless, damp cellar dwellings of the poor many an infected child lies without medical attention. This child has probably given the disease to others while he still attended school, and the contagion is carried further by brothers and sisters. The regulations of the school should prevent the spread of infections by excluding all those who show symptoms of disease, and keeping them at home during the time of illness. Children in the same household should also be prevented from coming to school. Furthermore, care should be taken so that the excluded children do not mingle with their companions on the playground. This isolation should be lengthy enough to prevent all possibility of infection, which varies with different diseases.

Frequent inspection by the school physician is another means of prevention. The teacher if he is familiar with first symptoms also can do much to ward off infections, especially as he is in a position to know what is the normal condition of the child. A case of violent contagion which has spread through an entire class may necessitate closing the whole school, and at any rate, requires thorough disinfection.

It is likewise desirable for the children to be informed about infections and how to avoid them; children should be asked to report immediately any departure from normal health. In the case of a spreading infection, the parents should be notified so that they may watch their own children and keep them at home when the first suspicious symptoms occur.

Our subject would grow to undue proportions if

we attempted to discuss in detail all the physical disabilities related to school life, but two difficulties—nearsightedness and spinal curvature—demand attention.

Myopia (nearsightedness).—The demand made upon the eyesight of children is very great. It is a matter of scientific knowledge that the number of children who are nearsighted and the degree of nearsightedness increase from grade to grade and from school to school as the children advance in school life. This fact which was first demonstrated forty-five years ago by Herman Cohn of Breslau in an examination which he made of the eyes of 10,000 school children, has since been corroborated by a number of other investigators. The blame can not be placed wholly upon the school itself; the homework, done often under unfavorable conditions, contributes its share. Another cause lies in the reading of badly printed books in a poor light, that of dusk, for instance.

The argument has been advanced that nearsightedness is no disablement to an educated man, who works on nearby things and can see them with ease. That an argument of this sort should be advanced at all is astonishing. Common sense tells us that the nearsighted person can by no means be as well off as the man with normal vision. Moreover, not all nearsighted pupils will desire to become pedants or clerks; some might wish to become soldiers, sailors or foresters. The nearsighted man is greatly discomfited if he breaks or loses or forgets his spectacles, is humiliated when he passes an acquaintance on the street without recognizing him; he can not find his way about in the

country, or enjoy a beautiful view as keenly as a normal-sighted individual. Disadvantages are already felt during childhood. K. E. Weiss says: "With a diminished function of sight, fewer sense perceptions, and hence fewer concepts, are possible; the nearsighted child therefore enters school with a complex of mental images entirely different from that of the normal-sighted." No one who knows conditions as they are, and as they will no doubt long continue to be, will assert that all nearsighted children can get proper glasses; and even if they have such glasses given to them, they will not wear them.

The school can not shield itself behind the above extraordinary argument, particularly as nearsightedness may lead to other evils, bad posture for instance, and bad posture in turn may still further increase the defect of the eyes. It has been pointed out by Berger of Krefeld (Germany) that nearsightedness in its early form can be corrected and the vision sharpened if the individual arranges his life so that he may have long-range vision; gazing at distant views in the country may help, according to Kertzsch of Quedlinburg (Germany). At least the muscle tension of accommodation is relaxed.

Spinal Curvature.—Of the various malformations of the spine, all of which deform the body, lateral curvature or scoliosis is most to be feared. According to the degree of curvature, other evils, as disturbances in circulation, result. The relative number of children who develop spinal malformation during the first year of school life is very great, and the number increases steadily during the second year. That the school is

to blame in part for this condition cannot be denied; though natural disposition plays an important rôle and, as in the case of nearsightedness, the home is also to be held accountable; it must be remembered that the homework which requires sitting is largely that of the school. The greater percentage of spinal curvature is found among girls, whose weaker musculature and bone structure offer less resistance to harmful influences (cf. p. 120). Spinal curvatures once started are corrected with great difficulty; frequently it is impossible to straighten the bent back, and many parents later spend large sums of money and infinite pains trying to correct that which should have been prevented in the beginning.

Subnormal Children.—The recognition of definite "school diseases" was the first incentive toward securing the services of the school physician, but since then the scope of the work has been extended, and the school physician to-day must examine children who have not yet been to school, but are about to enter. An examination of the school records of Wiesbaden (Germany) for 1898–1899 showed that of the 970 children entering school only 50 percent were in a normal condition of health; in 1901–1902, 64 percent of the 833 entrants were below par. Formerly in Dresden when it was the custom to ascertain the state of the pupil's health from the parents, only 16 percent of children entering school were found to be sickly, but since the time of medical inspection the percentage has risen enormously; for instance, in 1901 in the third Dresden school district of the 664 children examined 44.27 percent were found sickly; and in

1902, of the 479 children entering school 79.01 per-cent were pronounced subnormal. These higher percentages are due to the more thorough examinations; the findings emphasize the need of preventive measures to conserve the health of children. Medical examination reveals the fact that many children are physically unfitted for the work of the schoolroom. When in 1900 the first examinations were made in a number of Berlin schools, fully 300 out of the 2,500 children were found unfit for school. Most of the rejected children were in a state of general weakness after recovery from a severe illness such as scarlet fever; or they were suffering from rachitis or anemia—that is, physical conditions to be determined only by a physician.

The School Physician.—It is evident from the foregoing discussion that the work of the school physician is to be advocated in the interests of the public, as well as in those of the family. It is the acknowledged aim of teachers and school officials to make the education of children a wholesome process, but unfortunately school men sometimes fail to realize this ideal in individual cases. This statement, which is based on personal experience and a study of extensive literature, is made with certain demands in mind, demands which the school, embodying the idea of an institution for compulsory education, has naturally come to impose upon children. The lack here is not of good intentions on the part of school men, but rather of clear insight which neglects to make use of many possible preventive and constructive measures in the school. A long-continued study made of the

legislative enactments in force in various civilized countries, so far as these enactments concern school hygiene, reveals a deplorable lack of properly directed effort toward hygienic ideals, even in cases where an excellent model is at hand and finances need not be considered. An improvement may be hoped for only with the help of expert assistance, as has been demonstrated in those countries where progress has been made. Excellent work has of late been done in some of the German states, especially in the smaller ones.

The demand for the school physician is not new; the need was felt more than a century ago, and during the past fifty years it has become imperative. Previous to that time sanitation had been generally in charge of public health officers, with unsatisfactory results. In no country has there been so much discussion and controversy about the school physician as in Germany. It would hardly be of interest to elaborate the details of this discussion at congresses, in pedagogical and medical circles and in the press of these professions, but it may be useful to sum up briefly the imagined dangers of the school physician problem. Teachers feared above all that the school physician in the rôle of a new kind of inspector would curtail their limited freedom of action, and that he would make offensive censures. As a matter of fact, such has not been the experience in countries where the work of the school physician has been observed nor has it proved to be the case in Germany.

School physicians are now employed in hundreds of cities in Europe and there has been no evidence that these fears were justified; very few complaints

have appeared in the educational, medical, or general press. Conflicts are possible wherever human beings congregate, and conflicts between the teacher and the school physician may not be entirely avoided in the future, but experience has proved this much, that the medical inspection of school children by trained physicians is eminently desirable and that the objections against this system are largely figments of the imagination.

It might have been expected that objection to the school physician would be based on another argument, that of increased work for the teacher, and as a matter of fact, the introduction of new provisions such as school baths and games has thrown an additional burden upon the instructor, not only in keeping records of these activities, but in actual physical effort, as the weighing and measuring of children, and testing their vision and hearing. In Switzerland and in some parts of the United States teachers are required to assume these duties. In some cases of this kind it would seem to be only fair to make some financial return for the extra services demanded of the teacher.

In the elementary schools of to-day there is little protest against the school physician but this cannot be said of the higher institutions, although, according to Griesbach, many of the secondary schools in Germany have recently expressed themselves in favor of medical inspection, and a number of eminent educators, Dörr, M. Hartmann, Herberich, Harn, Schiller, and Schotten have used their influence in this direction. But at all events, the situation in the secondary schools with respect to medical inspection has not progressed to

anything like the same extent as in the elementary schools. The reason seems to lie in a fear that the curriculum will be disturbed and the demands now made upon pupils will be criticised unfavorably. It is possible that this fear is justifiable, but it should be impressed upon the high schools that it is the first obligation of the school so to arrange its educational plans that there shall be no transgression of the laws of health, and the high school teacher should be made to see that it is desirable to cultivate an ideal of good health, which should lead him to seek, rather than oppose, the coöperation of the school physician. As to the limitation of the teacher's authority, that must rest with the school board. In Sachsen-Meiningen, Hungary and Saxony, where school physicians are employed at all the higher institutions of learning, the plan has worked out, it seems, with practically no friction. Undoubtedly, the introduction of medical inspection into high schools will yield a mass of observations and experiences which will be of the greatest possible help for school boards to formulate plans for a more hygienic system of education.

School conditions in the higher institutions may be regarded as more favorable than in elementary schools. The material in high schools is less heterogeneous, being the result, more or less, of a process of selection; but it is also true that large percentages of even these selected children have received no systematic medical examination. The argument of frequency of nervous disorders in the higher grades of the high schools has already been mentioned. What is most needed is

a clearer understanding of health conditions among young people, and this can be gained only with the assistance of the school physician. This is so significant that it seems hardly possible that the school teachers, men and women of culture, will seriously continue to oppose an "innovation" which promises at least to afford real insight into present conditions, and holds out a hope that these may be improved with added knowledge. So far as the problems of the school building—location and equipment are concerned—we already have at hand a mass of investigations made both by physicians and instructors. That in this direction also there is great room for improvement is revealed by a personal study made of all the higher schools in a whole state. In consequence of such surveys of school buildings and equipment, it is possible to make suggestions for improvement. If school physicians do lack technical knowledge of hygienic school equipment and knowledge of the hygiene of instruction that is not to be held to their discredit, as they have not been especially prepared in this branch. Their most important work, the diagnosis of diseases or defects among children, would be rendered still more significant if the physicians' training had been especially directed to making examinations of eyes, ears, nose and throat; or better still if specialists in each of these branches could be employed, as is already the practice in some countries.

Another obstacle which has made the solution of the problem difficult has come from members of the medical profession itself who have feared conflicts between school physicians and public health officers, and

between school physicians and parents. It has been the fear of the family physician that the work of the medical inspector in the school would interfere with and limit his own practice. As a matter of fact, these fears also seem to be unfounded, for we hear of few conflicts between school physicians and general practitioners. So far as the relations of the school physician and the health officer are concerned, the custom in Germany is that the city appoints the school physicians, who are also allowed to augment their income by private practice. With a clear understanding of the division of work, friction is not likely to arise. Of course, a more desirable plan, and one which the author advocated years ago, would be to select from a large number of such school physicians those who are especially efficient and are interesting themselves in the school work, and provide them with a salary sufficiently remunerative to enable them to discontinue their private practice. Under these circumstances the school physician would be able to specialize on his work to an extent which is impossible to a practising physician. At present, there is small incentive to a physician to devote himself intensively to the school work which is usually dropped as his practice increases. It must be remembered that generally really efficient service can be secured only when an adequate salary, with a prospect of advancement, can be offered as an inducement. For larger cities it would seem to be most practicable first to increase the number of public health officers who are in charge of the school work in the various districts; next to make a selection of such as are especially fitted for the

work of medical inspection in the schools; and then to afford the latter opportunity for further study in this field.

Conflicts with the home are possible, for instance, when a spoiled child who simulates illness is found to be normal by the school physician; or there may be critical situations in the case of young girls who refuse to be examined by a young physician even in the presence of a woman teacher. Such cases, however, constitute but a small fraction of the total school population. The difficulty in the latter instance might be overcome by the appointment of a number of women doctors, as is the custom in some countries. In general, the procedure in dealing with parents is to advise them what needs to be done for the child, so that where the parents can afford it they may consult their own family physician. The result will be that the family physician is consulted more and not less frequently. Indigent parents should be referred to a proper clinic or dispensary. Unfortunately, experience everywhere shows that where the parents have been notified only a very small percentage of children receive treatment, partly because the parents are negligent though they may be quite able to pay for consultation, and partly because for those who can not pay there are not enough clinics and dispensaries. It may also be that the mother cannot spare the time to go far to a dispensary and cannot wait long after she gets there.

School Nurses.—For these reasons, the service of a school nurse is of the greatest significance. The school nurse was first employed in London in 1901; the example thus set has been followed extensively in Great

Britain and the United States, and the custom is spreading also slowly in Germany and Switzerland. These nurses go into the homes and confer with the mother, showing her how to rid the child of pediculosis, how to syringe the ear in case of a discharging disease, etc.; the nurse also takes children to the dispensaries. In short, she sees to it that the treatment recommended by the school physician is carried out, without cost to those who can not afford to pay, with cost to those who are financially able. The school nurse marks a great advance in the work of medical inspection of school children.

School Clinics.—Another mark of progress is the establishment of school clinics. This work, begun in 1902 by Jessen in Strassburg (Germany) in the form of a dental clinic, has since then spread over all the civilized world so that clinics now exist in many cities. All children are examined and those who cannot pay have their teeth attended to free of charge, or they pay a nominal sum, while the parents who are able to pay for treatment are advised to do so.

Different cities have general school clinics where treatment is given and slight operations are performed. The problem of free medical treatment of the poor in all advanced countries is recognized as an important question; it is most complex, but its solution can no longer be ignored. It is a well-known and sad fact that often those who cannot afford to pay will not go to the clinics—simply because the service there is charity. What is needed also is a deeper feeling of responsibility on the part of the parents, and laws forcing parents to secure treatment.

The indications are that medial inspection of schools and school children will eventually be introduced into all classes of schools in all civilized countries, though not with equal rapidity in all, and that the country which introduces it earlier will reap the benefit earlier, as is the experience in all other cultural movements. Medical inspection exists to-day to a greater or less extent in all civilized countries, although in none of the greater European continental states has the problem been adequately solved for the public schools. Progress has been made in some countries, the attempt at meeting the difficulties by state law in other countries has been a failure, while still others have made no serious attempt to solve the problem. The greatest difficulty of all is presented by rural communities.

Historical Survey of Medical Inspection.—Belgium stands to the fore, not only alphabetically, but as the country which first adopted a system of medical inspection in its schools. School physicians have been appointed in Brussels since 1874, and the example has been followed by other Belgium cities. Many features of the old Brussels system have served as a model. A specialty of the Brussels system is that the school physician shall prescribe tonics, codliver oil or iron, to those children who may be in need of these helps, and that the medicine is to be taken regularly in school under supervision of the teacher. As far as we know, only one other city in another country, St. Petersburg in Russia, has adopted a similar rule. The school records show that about 10 percent of the children in the schools of Belgium every year are in need of this preventive treatment, and that the results

have proved most satisfactory. Belgium also has good school clinics.

In Germany, Saxony has taken the lead since 1892, when 15 school physicians were appointed in the city of Leipsic. Conditions in Germany differ very much in the different states. The work has been well summarized by Schubert in his book on medical inspection in German schools, though much has been done since then. According to Schubert, Sachsen-Meiningen has the greatest number of school physicians. As a result of the untiring effort of Leubuscher, school nurses have been installed, medical inspection has been introduced also into the higher schools, and a beginning is being made in the country districts.

The system of medical inspection established in 1896 in the city of Wiesbaden deserves particular attention; it has served as a model for many cities introducing medical inspection, and many others have already modified their plans in conformity with its provisions. In Wiesbaden the parents of school children are informed by circular about the aims of the system. The beginners, after they have presented a certificate from their family physician, undergo a first, rather rapid examination by the school physician with respect to contagious diseases and vermin. Later on, in the course of the first month, they are examined with greater care to ascertain whether regular medical supervision or special concessions in their school work may be necessary. The mother is invited to be present at this examination. The results are embodied in a health report which is filed in the school and which when the child leaves is sent to the other school that

he enters. The report of every child who needs medical supervision bears the words "medical control." The child is re-examined in the third, fifth and eighth year of school life. After the last examination, as it may seem desirable, the parents are urged to consult with their physician before deciding upon a calling for the child.

The school physician has office hours in the school building every two weeks, more frequently in the case of contagious diseases. On the day preceding the visit of the school physician, a circular is sent to the various classrooms, on which the different teachers mark the names of those "medical control" children who are to be examined. The classroom teachers then submit the health reports of such pupils to the school physician. The physician spends the first half of his time visiting the classrooms, so that each room is examined at least twice during the term as to heating, ventilation, seating, etc. The second half of the time he spends in interviewing, in a private room, the children whose names he has on his list. The sick ones he recommends to the care of the family physician or to a clinic; the small children carry a note home explaining their condition. To ascertain whether absences from school are justifiable, the school physician may have to visit a number of children in their homes if he is so directed by the principal. The school physician is not permitted to give directions to the personnel of the school, but he has the right in case his suggestions are disregarded to complain to the commission on school hygiene; in urgent cases he can report to the superintendent of schools or the health

officer. He enters his remarks about sanitary and hygienic conditions of the schoolroom in the hygiene book kept in the school and makes regular reports to his chief, who includes them with others in his own report to the city authorities. The school physicians hold general conferences to which the local health officer is invited when matters of sanitation are under discussion. Resignations are adopted at three months' notice, but if a school physician neglects his duty he may be dismissed without further ceremony. Germany has many variations of the Wiesbaden plan, but the matter of treatment everywhere still needs improvement. Mention must be made in this connection of the work done in Berlin to extirpate a certain tenacious hair disease which is relatively rare in Germany but very contagious. About 100,000 children were examined and the few whose hair really was diseased were cured—at an expenditure of enormous sums of money, which might be considered small in comparison to the cost of extirpation if the disease had spread, but which under the particular circumstances seems high.

England and Wales are establishing medical inspection of schools through the state—a great step in the advance of progress. The Education (Administrative Provisions) Bill places the duty of providing for the medical inspection of school children, as well as the power to make other arrangements for the health and physical welfare of children, upon the local authorities. The state contributes annually a certain amount per capita attendance (a matter of about $70,000,000), and each community has not only a

material interest in good school attendance but desires to meet the state requirements, because in cases of negligence the state contribution can be withdrawn. This places a valuable weapon in the hands of the state authorities in enforcing medical inspection of schools. In 1908–1909, 314 of the 328 school districts had school physicians and 55 had already provided for the treatment of children; in 1909–1910 there were in 152 such districts school nurses. Admirable work has been done in some rural communities, and as a state system of medical inspection the English procedure takes first rank. Comparable to English progress in these matters is that made during the past few years in certain states of the United States where legislative enactments on the subject have been passed.

In Austria in 1909 medical inspection was extended to the state normal schools. In this way the prospective teachers become thoroughly familiar with the workings of a system of medical inspection before they enter their profession. The very success of these future propagandists will depend very much upon the way in which medical inspection is carried on in the normal schools. As early as 1885 the appointment of school physicians by the state was begun in the higher schools of Hungary. These physicians must present evidence to show that they have been trained for the work. Their duties include sanitary inspection of the school building as well as the examination of school children. The curriculum of the last two years of school includes facultative instruction in hygiene.

Our historical survey closes with Japan where

medical inspection has been prescribed by law since 1898, and where it may be suspended only at the discretion of the governor in communities numbering less than 5,000 inhabitants. In 1909 the number of active school physicians numbered 6,975, and these men covered only about 54 percent of all public schools. The outlay for medical inspection in the schools of Japan seems exceedingly small, while the number of school physicians is an imposing one; but unfortunately exact information is lacking on the most important point—the actual benefit derived therefrom by the individual child.

V

HYGIENE OF THE TEACHING PROFESSION

The hygiene of the teaching profession can be treated only very generally because it must cover many different conditions and different kinds of schools. The profession of the teacher means taxing work, which differs for instance from the work in an office by the intensive application, which can not always be spontaneous, demanded at every minute of the teaching day. This intensity has moreover been further deepened by the new methods of teaching. To speak continuously in a large room, supervising at the same time a great number of children and holding the attention of every individual child, to deny oneself needed pauses for rest, to repress natural needs, all this means an enormous strain on the nervous system in general, with particular emphasis upon certain organs, those of the throat, for instance, all of which, as every teacher knows, is exhausting. The constant demand made upon the eyes and ears in the constantly interrupted attempt to stimulate thought processes of large numbers of individuals, whether instruction or examination be in progress, requires a supply of energy which can hardly be appreciated by the layman. Teaching in a schoolroom is very different from giving a private lesson to a single pupil, so far as the energy output of the teacher is concerned.

And the duties of the teacher are not ended when school is over. The written work of the children must be corrected, which in the case of large classes and difficult subjects may become an instrument of mental torture for the teacher. In this way the teacher may get into a condition of overwork which can not fail to be injurious to health.* Because of the disadvantageous circumstances under which many teachers must work, it is not surprising that many fall victims to chronic nervous excitability and chronic disturbances of the organs of speech. The degree to which nervous excitability may go is demonstrated by the excitement caused among the teaching profession in Germany by the discussion of the Liability Act in regard to accidents of pupils. Women teachers especially should be shielded from overwork. Persons of delicate health, those having a nervous tendency, or those afflicted with serious defects, should not choose teaching as a profession. A sound constitution, ability to endure, patience, poise and a happy spirit are invaluable assets of persons who intend to take up a teacher's career.

Finally, it must be emphasized that the work of the school physician should be directed also to obtaining a clearer understanding of what is needed to insure hygienic conditions for teachers. It is not yet the function of the school physician to make routine examinations as to the state of health of instructors, but it is surely not too much to ask that the physician

* For a detailed discussion of the hygiene of the teaching profession the reader is referred to pages 374-385 of the larger work, "Handbuch der Schulhygiene."

shall report unhygienic conditions wherever he finds them in the school and that if teachers desire to consult him about school work or wish advice about equipment, he should be willing to give his services. By following a course thus outlined it will be possible to obtain accurate data as to what is needed to raise the health and vigor of the teaching profession to a higher level.

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It has not been possible in the small compass of this volume to present more than a cursory discussion. Those who may desire more detailed and comprehensive data on the various subjects included under the term school hygiene are referred to the larger work on the subject, "Handbuch der Schulhygiene,"* which contains in addition to extensive discussions and excerpts from original studies, a very large and carefully compiled bibliography. In addition a very small number of new works may be of help. Arranged under the various headings they are:

The Schoolhouse and its Equipment

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